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Hold the line or give in to the sea?

Deliberative citizen engagement in governance to adapt to sea level rise on the shoreline

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ABSTRACT

Shorelines, including the Inner Forth in Scotland, are facing unprecedented challenges with climate change. Rising sea levels mean that stakeholders need to work closely to deliver adaptation, such as the nature-based option of intentionally realigning shorelines landwards to give the sea more space. Drawing from workshops, interviews and surveys with citizens living on the shores of the Inner Forth, and semi-structured interviews with locally active organisations and land-owners, this thesis examines the governance context and methodological issues of citizen engagement in adaptation, with a focus on the use of participatory valuation tools. In particular, I develop citizen-oriented methodological options for integrated and deliberative valuation to address issues of inclusivity and knowledge gaps. The novelty of the deliberative valuation presented here is based on the explicit consideration of awareness gaps from both expert and local perspectives.

The results show that even though emerging collaborative institutions are broadening the spectrum of stakeholders engaged in shoreline governance, they do not yet include representative groups of citizens. Empirical material presented here suggests that bridging the citizen engagement gap would potentially support the uptake of nature-based adaptation options, enhance legitimacy of decision-making processes, and bring other-regarding moral principles and biocentric values into decision-making. However, as the valuation results from the citizen workshops illustrate (in resonance with the central tenets of the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services), commonly applied valuation

methods may be too narrow in their framing to capture plural values and world views. Furthermore, the ability of citizens to engage in adaptation is limited by knowledge gaps regarding the local area and the pressures it is facing. The deliberative citizen-oriented approach to valuation developed here led to the emergence of clearer priorities, improved choice model fit and participant confidence, providing empirical evidence to support the premise that deliberation builds citizens' ability to engage in adaptation.

In addition to contributing empirical insights on how adaptation governance is unfolding on local scales, this thesis responds to methodological discussions on the use of valuation for citizen engagement in three main ways: 1) it demonstrates that the choice of value framings impacts the engagement outcomes; 2) it illustrates how deliberative valuation can shape citizens' attitudes towards the uptake of adaptation measures; 3) it provides evidence of the specific role that local knowledge plays in improving the outcomes of deliberative valuation.

SUMMARY

Communities on the shorelines of Scotland are beginning to wake up to the rising sea levels, including in the Inner Forth, where the River Forth flows into the North Sea between Stirling and Grangemouth. The Inner Forth is one of many seascapes of Scotland that will dramatically change, as sea levels are predicted to rise by 54 cm by 2080 (Lowe et al. 2009). As a result, changing the way Scotland's land is used and managed will be fundamental to ensuring that local areas can cope with climate change in the coming decades. Farmers whose lands will be increasingly covered by rising sea water will struggle to maintain agricultural production if their land repeatedly floods. People living near the shorelines will also face unprecedented risks of flooding. In some areas of Scotland like the Inner Forth, shorelines may need to be intentionally realigned to allow landward retreat - by moving seawalls further inland to give the sea more space.

This thesis examines the role of citizens in the adaptation to climate change. Based on workshops, interviews and surveys with people living on the shores of the Inner Forth, and interviews with land-owners and locally active organisations, I show how engaging citizens can add to the legitimacy of adaptation and would in fact bring other-regarding moral principles and nature-regarding values into decision-making. However, several issues remain that limit the usability of current tools for citizen engagement in adaptation. This thesis focuses on two of these. The first issue concerns inclusivity, as single methods used on their own do not capture the variety of values and world views held by citizens (1). The second issue is about knowledge gaps, as citizens do not know enough about their local areas and the pressures they

are facing to engage in adaptation (2). Here I add to the existing literature on the use of valuation tools by developing a workshop format that addresses both challenges of citizen engagement by combining tasks that emphasise different concepts of value (1); and by explicitly considering awareness gaps both in terms of local and scientific knowledge (2). By showing how this approach increases people's confidence in taking part, establishes clearer priorities for shoreline management, and reduces uncertainty in modelling the decision processes, I add empirical material to support the idea that (carefully designed) deliberative and discussion-based methods help to build citizens' ability to engage in adaptation.

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STUDENT DECLARATION

This thesis has been written by me, Anja Helena Liski, and is my own original work, except where indicated throughout the thesis and summarised below. No part of this thesis has been submitted for any other degree or professional qualification.

August 2018, Edinburgh

CHAPTER	**SECTION**[1]	**CO-AUTHOR**[2]	**%**
3	3.1 Introduction	P.A.	30
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[1] Excludes sections of thesis that are entirely student's own original work.

[2] Pontus Ambros (P.A.), Torsten Krause (T.K.), and Mark Koetse (M.K.)

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CHAPTER 1.

Introduction

"Why did you come here? We are actually quite lucky here, with the hills, the valley and the meandering Forth", asked a fellow passenger as I stepped off the train in Alloa for the first time in May 2015. I had searched the map of the Inner Forth, an estuarine area in the central belt of Scotland, to select a place that could serve as a local metaphor for the increasing risks and vulnerabilities to climate-related hazards caused by human-induced global environmental change. The town of Alloa, on the northern bank of the Inner Forth, seemed right: on that Sunday morning it was so quiet but having read a book

Figure 1. The Windings of the Forth (or The Forth near Alloa, Stirling in the distance) by Alexander Nasmyth (ca 1835).

about the environmental history of the Firth of Forth by Smout and Stewart (2012), I knew that Alloa was no stranger to environmental and social change.

Like many old port towns on the shores and the hillfoots of the Inner Forth, Alloa had been transformed time after time, particularly in the past 200 years (Figure 1). It had industrialised, then post-industrialised, and, as it seemed from the conversations with the local residents, its rural sense of place was gradually being diminished due to increasing development pressures for housing (Figure 2). Many of the neighbourhoods on these shores (e.g. South Tullibody) experience 85% more social deprivation compared to rest

Figure 2. Photos 'Two Bridges' and 'Crams' at the top (both 2011) and 'Alloa Surge Tide' (2014) by Brian Smith, used under the CC BY-NC-SA 2.0 license.

of Scotland, some of them (e.g. South of Alloa) as much as 95% more (Scottish Government 2016a).

Looking across the river Forth to the small island of Alloa Inch, is the abandoned farm house (Figure 3) that is now home to a family of otters. It pictures what could happen on the mainland shores of the Inner Forth in the coming decades: the land on the island had been reclaimed from salt marsh for farming since the 1800s, when the Inner Forth valley (for all we know) resembled the view in Nasmyth's painting (Figure 1).

Figure 3. The abandoned Alloa Inch Farm Brian Smith (2011), used under the CC BY-NC-SA 2.0 license.

The farmer family who had lived on the island has now left, and it is now submerging into the Forth, as the land is subsiding due to coal mining. Now, the farmers on the Inner Forth mainland are also coming up against the sea. Over 50% of the marshland on the shoreline has been reclaimed for farming by building seawalls (Smout and Stewart 2012), which may not keep the water out during peak events as sea levels are projected to rise by up to 54 cm by 2080 (Lowe et al. 2009). Already, water has risen over the top of the seawall in 2015 in Airth, one of the low-lying farmland areas in the Inner Forth, raising concerns of flooding in the village behind it.

Returning to the train passenger's question: I came to Alloa to examine citizen engagement in adaptation governance, both in terms of how the governance context in which it takes place supports adaptation to climate change (1), and how methodological choices shape the inclusivity (2) and citizens' ability to engage (3) in adaptation. In light of these three research aims, I will first broadly situate this research in the adaptation literature.

Thematically, adaptation is a particularly interesting field of climate action because it is a less established effort than the mitigation of climate change (Anguelovski and Carmin 2011), which is largely driven by regulation and market-based approaches, such as carbon trade. Adaptation actions, on the other hand, are seen to be driven by a wider range of stakeholders including residents (Mees et al. 2016) and businesses (Klein et al. 2017) on local to regional levels (Huitema et al. 2016).

Theoretically, this research is embedded in the growing field of environmental social sciences, *adaptation governance*, which aims to understand what governs how societies adapt to climate change. Adaptation governance is defined here as the way in which adaptation actions, both individual and collective, are shaped by structures and processes by which societies share power (Lebel et al. 2006). Environmental governance studies (and more recently adaptation governance studies) commonly apply Elinor Ostrom's social-ecological systems framework (1990) to structure society's relationship with the changing environment, as I will illustrate in the literature review to follow. Researchers in the field of adaptation governance (e.g. the special issue edited by Huitema et al. 2016) look at how the government, stakeholders and citizens engage in defining adaptation problems, designing and using adaptation policy instruments, and how these actions affect adaptation outcomes. Adaptation governance studies ask questions about the actors, institutions and their relationships (another recent special issue edited by Driessen et al. 2016):

Are the actors influencing or benefiting from adaptation actions able to collaborate? Are the existing policy instruments effective? To what extent do the bridging mechanisms help to coordinate adaptation actions between actors?

These studies lean on the concept of adaptation governance primarily in a descriptive manner to draw out how governance supports adaptation. Similarly, the first research aim (1) above adopts a descriptive stance towards the theory of adaptation governance by examining how existing norms, perceptions and collaborative practices of governance support local-scale adaptation. Theoretically, the two latter research aims (2-3) are more loosely situated in the adaptation governance literature as they are primarily about methodology, and merely take their rationales from the persisting participatory issues of adaptation governance. Methodologically, the latter research aims (2-3) sit more firmly in the applied science domain of ecosystem services valuation that can be applied across various thematic areas of environmental sustainability.

Before outlining the research questions and structure of this thesis, the remainder of this chapter presents a brief two-part literature review of the key ideas of adaptation governance and citizen engagement that underpin the research. The first part charts how concepts of informal governance (social norms and perceptions) have so far been applied to analyse adaptation, and the increasing relevance of these informal governance structures in the emerging policy context of devolving adaptation responsibilities to local to regional scales. Furthermore, empirical evidence of existing adaptation practices in the developed country context is mapped against a lineage of pertinent governance theories. The second part of this literature review draws the conceptual and empirical background for citizen engagement by defining the extent to which ecosystem services valuation lends itself as a tool for participation. After outlining tentative evidence of how deliberative activities potentially shape outcomes of adaptation actions, I show how two aspects of valuation (local-expert knowledge gaps and value framings) parallel issues of citizen engagement identified in participatory theory and adaptation governance. To contextualise how the participatory process developed here sits in relation to central concepts and applications of deliberative citizen engagement more broadly, I position my approach with respect to the theory of knowledge integration in functional social sciences, the expert-citizen relationship in sociology of risk, and analytic-deliberative applications of participatory theories.

1.1 Citizen engagement in adaptation governance

In developed countries, the governance mode of adaptation is partly being driven by the devolution of jurisdictional adaptation responsibilities to local levels (Johnson and Priest 2008; Nye et al. 2011). The devolution of responsibilities creates a new set of challenges for implementation: locally derived evidence is often not available (although local authorities are increasingly aware of climate risks), and adaptation action in the United Kingdom so far has been limited due to budget cuts (Porter et al. 2015).

In addition to the limitations in evidence and resource, governance research has conceptualised adaptation case studies to frequently involve so-called 'social dilemmas' (Ostrom 1994), where individual benefits (e.g. crop yields) have trade-offs with community or societal benefits (e.g. regulating ecosystem services to support adaptation). Implementing nature-based adaptation solutions, such as the restoration of reclaimed farmland back to wetland, are hindered by these social dilemmas on local level. I use this framing of adaptation to determine which actors are engaged and justify the focus on citizens in the research. From a policy perspective, governance scholars have suggested that addressing social dilemmas requires "forward-looking" action, which are currently not mainstream in environmental policy cycles such as land use (Huitema et al. 2016) and shoreline (Nicholson-Cole and O'Riordan 2009) planning, or adaptation (Ford et al. 2011). Governance studies, therefore, are seen to provide a vital social side of the coin in producing environmental sciences that supports adaptation decisions (Moran 2010).

Recent contributions of environmental social sciences that draw attention to the importance of social norms in determining the outcomes of adaptation actions (O'Riordan and Jordan 1999; Dumaru 2010; Ensor and Berger 2009) have been important to how I deconstruct the concept of 'adaptation governance' in the Inner Forth. Stakeholder acceptance of implementing nature-based solutions, such as wetland restoration to reduce shoreline flooding and erosion, is an example of such adaptation actions. The focus on norms rediscovers the theory of new institutionalism that emerged in the 1980s (e.g. March and Olsen 1984), in contrast to old institutionalism studied in the early 20th century that focuses on the social theory of formal legal arrangements (Poteete 2010). Studying norms as units of adaptation governance, again, builds on

Ostrom's work on how institutions impact social dilemmas. Ostrom (2005) defines institutions as the "formal and informal prescriptions humans use to organise all structured and repetitive interactions". Her work has shown that in the broader domain of environment-society relations, all three types of institutions impact social dilemmas: rules, social norms and policy context. All three types have been shown to play a role in determining the outcomes of adaptation actions (Bisaro and Hinkel 2016; Abel et al. 2011).

Understanding social norms and associated preferences on local scales is viewed particularly important in the legislative horizon of devolving responsibilities to local and regional scales, to ensure that adaptation actions reflect societal or community priorities (Dumaru 2010) and that they fit within the broader governance context (Bisaro and Hinkel 2016). For nature-based adaptation such as managed realignment, studies commonly examine informal governance structures on one side of the social adaptation dilemma: for example, whether the public want nature-based adaptation (e.g. Myatt-Bell et al. 2002; Myatt et al. 2003; French 1997; Roca and Villares 2012; Luisetti 2011; Curado et al. 2014), and how their attitudes towards adaptation are influenced by norms (McFadden 2010; Kochnower et al. 2015) such as social trust (Jones et al. 2015). Brink and Wamsler (2017) and Jones et al. (2012) suggest nature-based adaptation pathways involving ecosystem restoration to be potentially more conducive to citizen engagement, because they increase the provision of multiple ecosystem services that people care about, and often link to mitigation actions which people understand better. I seek to produce a rounded view of the social adaptation dilemma by examining the tensions between the public's and the landowners' perspective, together with citizens' perceptions of what institutions govern their local 'social-ecological system', thereby contributing a more governance-oriented perspective to the body of local-scale studies that examine to what extent norms and attitudes support nature-based adaptation.

Theory and practice of stakeholder engagement in adaptation

For the remainder of this first section of the literature review, I will examine the linkages between theory and practice on who engages in adaptation. Recent observations of how adaptation is practiced across Europe by a range of stakeholders on local to regional scales

can be mapped to a lineage of governance theories, descending from polycentric (i) to participatory (ii) to deliberative (iii) governance:

i) In the **polycentric governance theory** (e.g. Berkes 2004; Lebel 2006), authority and resources should be allocated according to different governance levels with most influence to act effectively (Abel et al. 2011). This mode of governance has been supported by the Intergovernmental Panel on Climate Change to decentralise the regulation of natural resource use (Aylett 2010), although critics (e.g. Stoker 1998) are concerned that there is not enough clarity on who is accountable and who ensures compliance. In terms of legal responsibilities, the governance framework is already polycentric for certain strands of adaptation, such as flood risk management, because property owners have the responsibility to protect their properties (Newig et al. 2014). Adaptation governance is now increasingly polycentric at the statutory level, as public legal responsibilities are being devolved to local and regional scales in the UK (Penning-Rowsell and Johnson 2015) and elsewhere in Europe (Mees et al. 2016; Ford et al. 2011). The decentralisation of adaptation responsibilities poses a question for governance studies: is this statutory polycentrism being coupled with non-statutory polycentrism in adaptation actions? Adaptation governance literature is beginning to analytically approach the consequences of such polycentrism for equity and efficiency (as summarised by Mees et al. 2012), but so far there is less descriptive research on how private stakeholders (Juhola and Westerhoff 2011) including citizens (Brink and Wamsler 2017) engage in adaptation actions on a non-statutory basis.

ii) The **participatory (or inclusive, collaborative) governance mode** (e.g. Ansell and Gash 2008; Newig and Fritsch 2009; Healey 2006) extends the polycentric mode by explicitly including citizens as direct participants in governance. This model grew in popularity in the 1960s as an alternative to the conventional model of representative democracy (Escobar 2017) and is seen increasingly relevant across broader societal scales as people participate less through conventional democratic formats (Sinclair-Chapman et al. 2009). Citizens are invited to not only vote to select the governors that represent them, but also participate directly. In the broader context of democracy, the rationale for this mode of governance is not only normative (Escobar 2017) but also

instrumental, to create a sense of efficacy and build knowledge (Aylett 2010). Citizen participation is seen essential in achieving environmental goals more generally (e.g. Reed 2008) as well as in climate adaptation practices (Anguelovski and Carmin 2011). In the UK, France and Flanders, the policy rationale for promoting participation in the implementation of flood risk management is to reduce public costs (Mees et al. 2016). This 'responsibilisation' of private sector and citizens (Klein et al. 2017) has been interpreted as the neoliberalisation of adaptation governance (O'Hare et al. 2016). Despite the growing interest and increased uptake in e.g. emergency responses to flood events (Mees et al. 2017), citizen engagement is generally not yet mainstreamed in adaptation practices across Europe (Mees et al. 2016; Wamsler and Brink 2014; Wamsler 2016; Klein et al. 2017). Even where responsibilities have been devolved to local level, local authorities do not engage with citizens in adaptation planning (Brink and Wamsler 2017) or drive proactive modes of citizen engagement in adaptation (Wamsler and Brink 2014) apart from few pioneers (Wamsler 2017), for reasons relating to challenging past experiences and citizen opposition, leading to reluctance amongst staff.

The central assumption of sociology perspectives to participatory governance is that citizens have demonstrated their capacity to formulate policy (Fischer 2000). In the governance of adaptation, however, lack of public awareness of flood risk is posing a barrier to the implementation of government-driven adaptation practices across Europe (Meet et al. 2016). This key issue is examined in more detail the valuation context in the second part of this literature review.

iii) Since the 1990s, the idea of **deliberative democracy** has been built on the foundations of participatory governance (Escobar 2017) and is largely underpinned by Habermas' theory on communicative rationality that sets out philosophical principles for practicing deliberative democracy (e.g. O'Neill 2001). More recently, a growing body of literature on citizen engagement in deliberative democracy (Reed et al. 2017) examines how the deliberative practices position themselves with the predominant modes of representative democracy (Hysing 2013) and emerging polycentric arrangements (Newig and Koontz 2014). Its applications, such as deliberative

democracy forums, have been popular in environmental governance literature, as described by Few et al. (2007). In coastal and marine environment, the deliberative governance mode has attracted a lot of interest amongst researchers examining mechanisms to enable societal change in developed and developing country contexts (Glavovic 2016; Lloyd et al. 2013; Moser et al. 2012; Wynberg and Hauck et al. 2014). Yet in the adaptation context, empirical evidence on how stakeholders are engaged in the deliberations of adaptation planning is so far limited, drawing mainly from a few urban case studies in Australia (Akompab et al. 2013), Sweden and Germany (Wamsler 2017). For shoreline adaptation, however, lessons for citizen engagement can be learnt from work in related policy areas, e.g. planning stage of partnerships to restore rivers and deliver Water Framework Directive goals (Tippett 2005; Petts 2007; Koontz 2014).

In the adaptation context, authors have viewed deliberative citizen engagement as a means to address issues of social equity (Klein et al. 2017; Brink et al. 2016). Central to this is the inclusive and equal representation of citizens, which Mees et al. (2014) conceptualise to be a central facet of legitimacy in adaptation governance. There are examples where local authorities explicitly target deprived communities in adaptation practices (Carmin et al. 2012), but generally the evidence of adaptation actions with respect to vulnerable groups in developed countries is scarce (Ford et al. 2011). Several authors in the environmental governance literature (Huitema et al. 2016; Paavola and Adger 2006; Barker et al. 2008) highlight a gap in addressing issues of justice, specifically: how can deprived and vulnerable groups be effectively involved in deliberative adaptation practices? Although this is not explicitly addressed here, I produce the research through the engagement of citizens from some of the most deprived neighbourhoods of Scotland. Furthermore, the quality of the participation process, which Mees et al. (2014) also identify to be a major aspect of legitimacy, is important for situating my understanding of citizen engagement methods in the context of governance theories.

1.2 Valuation of ecosystem services as a tool for citizen engagement in adaptation governance

Valuing ecosystem services is an umbrella term for a diverse range of quantitative and qualitative approaches that examine the importance, perception, preference or plurality of a landscape or ecosystem property through symbolic, cultural, ecological and spiritual dimensions; or framing how ecosystem services flow and to whom (Chan et al. 2012; Iniesta-Arandia et al. 2014; Kelemen et al. 2014). Quantitative approaches to valuation, (including WTP techniques) systematically describe the flow, dynamics and interaction of ecosystem services within ecosystem service bundles and with human wellbeing (Reyers et al. 2013). Qualitative approaches focus on interpreting the meaning of values and the deeper held values that underpin them (Klain and Chan 2012; Satterfield et al. 2013).

My understanding of these 'valuing nature' techniques as tools of citizen engagement is based on an appreciation of *how* they invite citizens to participate. The most common methods of quantitative participatory valuation, stated-preference techniques (choice experiments and contingent valuation), invite participants to express their values as consumers who are driven by individual, pre-existing and static preferences (Sagoff 1988). In the 1990s, a new school of *deliberative monetary valuation* emerged to re-position participants as citizens through the combined use of monetary stated-preference techniques and deliberative processes (Jacobs 1997). Scholars advocating deliberative monetary valuation were motivated by internal and/or external critiques of stated-preference techniques (Lo and Spash 2013). Both critiques share the explicit recognition that participants' values are inherently constructed during valuation, rather than being merely revealed by the valuation instrument (Niemeyer and Spash 2001).

The external critique, from scholars that prescribe to more diverse value systems, is rooted in the earlier-mentioned normative theory of deliberative democracy (Jacobs 1997). This largely ethical critique is concerned with the reductionist articulation of non-utilitarian (Lo and Spash 2013) and incommensurable values (Vatn 2004). Here I engage with this critique in my justification for adopting group-based socio-cultural valuation methods alongside the choice experiment, forming the basis for integrated valuation (Jacobs et al. 2018) to allow a broader range of value dimensions to be articulated.

The internal critique, more technical in nature, is concerned with the issues of preference discovery and knowledge gaps (Álvarez-Farizo and Hanley 2006; MacMillan et al. 2002). The ontological stance I adopt here follows deliberative monetary valuation by viewing the participant as uninformed (Niemeyer and Spash 2001), in contrast with the ontological positions of both deliberative democracy ("capable of reflection") and conventional monetary valuation ("informed consumer").

Rationales for using valuation as a tool to engage citizens in environmental decision-making are generally motivated by varying degrees of instrumental (e.g. to describe values) and normative (by duty, rights or norms) rationales, as conceptualised by Habermas' (1987) communicative action theory. Recent efforts to synthesise and compare differences in rationale between instrumental and deliberative approaches (Raymond et al. 2014), deliberative monetary methods (Lienhoop et al. 2015) and valuation case studies from an institutional perspective (Carnoye and Lopes 2015) reinforce the observations from governance studies in that knowledge gaps and inclusivity remain pertinent issues in citizen engagement. This has methodological implications for the use of valuation as a tool for citizen engagement. For inclusivity, authors (e.g. Martin-Lopez et al. 2014; Jacobs et al. 2018) argue that different value dimensions can only be captured by using a combination of valuation approaches, because the valuation process determines the world views to be articulated. For knowledge gaps, deliberative approaches are needed to achieve fair and legitimate valuation outcomes, by helping participants to understand the values held by others, which has been found to lead to increased sharing of values within the group (Vatn 2009), empathy, consideration of future generations and the relations people have with nature (Crompton 2010). Deliberative valuation improves the quality of decision-making by allowing values to be discovered, raised and considered during the process (Spash 2007; Wilson and Howarth 2002).

Can diversifying framings improve inclusivity of citizen engagement in adaptation governance?

I start building the case for why participatory design of valuation methods is of importance against the backdrop of recent developments in the theory of participation (Reed et al. 2017). The most important insight from these developments, which draw from the empirical work of e.g. De Vente et al. (2016), Brooks et al. (2013), and Ansell

and Gash (2008), is that design is more important in determining the success of participation outcomes than local context. More specifically, providing information and power to all participants were found to be amongst the most important aspects of design, aligning closely with the understandings in governance and valuation literature on the importance of knowledge gaps and inclusivity.

Despite the diverse options available, methods for valuing nature and ecosystem services only serve a limited number of purposes compared with the full range of methods that are available across participation-oriented fields of enquiry. The full methodological menu varies from social-deliberative to individual-thin (Nabatchi and Leighninger 2015); conventional to empowering (Parking and Mitchell 2005); critical to consensus oriented (Aylett 2010); informal to formal (Vatn 2009); and bottom-up to policy-driven modes (Anguelovski and Carmin 2011). Valuation is an appropriate tool or vehicle for participation only in a limited number of these contexts. It is a conventional format, although well designed social valuation methodologies can indirectly empower through social learning (Kenter et al. 2015). There is limited opportunity for critical participation especially in highly structured quantitative methods (O'Neill and Spash 2000). Valuation is a formal institution (Vatn 2009) although it does not necessarily have policy impact despite its applications being policy-driven.

In addition to the limitations outlined above, each valuation task is founded on a specific pre-defined concept of value, and an associated framing of value, which may not lend itself for articulating different world views (Tadaki et al. 2017). For example, participants may be asked to evaluate how different places or features contribute towards goals that are pre-defined by the valuation analyst. From a participation perspective, this policy goal is reflected in the framing of the valuation task. The participatory theory by Reed et al. (2017), or the empirical studies it draws on, do not offer much on the potential importance of these pre-defined goals and framings on participation outcomes, apart from noting that language should be adapted for local contexts. Framing of valuation questions and tasks, however, is potentially an important factor that is pre-determined by the valuation analyst: if the policy goal is to protect human well-being, the task is founded on an

anthropocentric framing, whereas for a policy goal of protecting nature for its own sake, the valuation is founded on a biocentric framing (Morelli et al. 2016).

Determining the impact of framings on the valuation outputs is also a pertinent issue in ecosystem services valuation research. Overcoming the challenge of narrow valuation methodologies has recently received considerable attention in the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), which is calling for plurality in the way in which we value the environment in decision-making (Díaz et al. 2015; Pascual et al. 2017). The plurality refers to different ecological, socio-cultural and economic world views, which pair up with the three pillars of sustainability (Daily et al. 2000; Fanny et al. 2015). These pillars make up the process of 'integrated valuation', defined as the process of "collecting, synthesising and communicating knowledge about the ways in which people ascribe importance and meaning to nature's contributions to humans to facilitate deliberation and agreement for decision-making and planning" (Pascual et al. 2017). Whereas many have recently (Saarikoski et al. 2016; Czembrowski et al. 2016; Lo and Spash 2013; Langemeyer et al. 2015) focused on the technical challenge of developing new integrated methods, this thesis focuses on developing an integrated valuation process from a participation perspective. I develop a participatory process that is inclusive to plural world views, instead of using a single or narrow set of methods oriented towards a narrow world view. Different framings of value are used to understand how sensitive the participation outcome is to way in which people are asked to articulate their values.

Deliberation in adaptation governance

Deliberation is the second aspect of participatory valuation design explored in this thesis. From a participatory research perspective, deliberative practices in citizen engagement were central to the origin of participatory enquiry that evolved to address issues of environmental risks to society at local scales, to help local communities or workers build knowledge to meet their own needs (Fals-Borda and Rahman 1991). Current research on participatory enquiry continues to emphasise deliberation as an ability-building practice (Reed 2008; Weber and Christopherson 2002; Crosby 2003).

In the adaptation context, case-study based evidence from high-income countries (Abel et al. 2011) suggest that there is a need to improve capacity-building in adaptation practices: lack of local capacity to initiate and implement adaptation on local level is a common issue in high-income countries where sea level rise is posing a threat to shoreline infrastructure and development. Evidence suggests that deliberation is potentially an effective means to improve adaptation capacity: discourse-based analyses by Hobson and Niemeyer (2011) show that discussion-based deliberation increases participants' interest in taking adaptation action, reduces climate scepticism and increases consensus between participants. Case-study comparison by Mees et al. (2014), however, shows that even though deliberative participation of stakeholders in adaptation planning improved the legitimacy of decision-making process, it does not necessarily improve stakeholders' acceptance of adaptation actions.

The integration of local (Fazey et al. 2006) and expert (Fazey et al. 2004) knowledge, as examples from literature collated by Brink and Wamsler (2017) show, is one of the common elements of stakeholder engagement in adaptation actions. Integrating different types of knowledge is the main rationale of participation in the functionalist approach to participatory governance. This approach originates from the functional social sciences, in which the components (e.g. norms and formal institutions) of society that are required to sustain survival are conceptualised from the perspective of an individual (Malinowski 1944) or society as a whole (Radcliffe-Brown 1935). This knowledge integration goal remains pertinent on the agenda of participatory research (e.g. Raymond et al. 2010; Olsson and Folke 2001). Local knowledge can help to, for example, verify the suitability of expert-driven adaptation solutions in local contexts (Reed 2008).

This relationship between expert and local knowledge, however, is not a simple utilitarian exchange that improves understanding on both sides. Sociological scholars on risk have shown that expert and citizen perceptions of risk are different, and citizens do not simply take up scientific knowledge, but also evaluate its reliability based on their past experiences (Zinn 2009). As knowledge held by experts lacks locally derived evidence, conflict occurs between different knowledges in the context of environmental problems, as described in Beck's theory on 'risk society' (1986). This knowledge conflict is a fundamental element

to understanding and developing the relationship between citizens and experts in environmental decision-making (Fischer 2000). The need for deliberation is therefore not to educate citizens to fill knowledge gaps, instead, the direction of exchange between these knowledges is two-directional, as citizens also assess the position and views of the expert (Wynne 1996) and deliberate the differences between different knowledges (Beierle and Konisky 2000). More recently, Raymond et al. (2010) called for more work to identify deliberative methods to integrate different knowledge types, which remains to be a challenge in participatory research, as Huntington et al. (2002) illustrate. Even though the participatory valuation approach developed here does not integrate different knowledges, or address conflicting knowledges, it is the first deliberative choice experiment to explicitly address both local and expert knowledges in its participatory design.

The participatory process I develop is similar to many examples of practical decision-making in the sense that the design draws from different schools of participatory theory (Stern and Fineberg 1996). The most popular hybrid approach, combining elements from two or more participatory philosophies (see Renn and Schweizer 2009 for an overview), is the analytic-deliberative approach that integrates the analytic efforts of a functionalist approach with the consensus-seeking aspects of the deliberative approach (Renn and Schweizer 2009). This hybrid process consists of three main steps that iteratively bring together both expert and citizen perspectives: gaining knowledge, developing an understanding based on knowledge, and reaching consensus (Chapter 12 in Fischer 2000). From a legitimacy viewpoint, use of analytic-deliberative approaches to engage citizens in risk analysis has been advocated at national-level science-policy interfaces particularly when citizens have little trust in decision-making, and policy outcomes are highly uncertain (Stern and Fineberg 1996). Although applications of analytic-deliberative approaches are still limited in adaptation, it may have potential in easing the use of climate science in adaptation, one of the common challenges in the practice of adaptation on local level (Kirchhoff et al. 2013). Studies on the adaptation practices have shown that unfamiliarity with the evidence is a common barrier that prevents policy-makers from taking adaptation action (Archie et al. 2014), hindering action amongst non-experts (Porter et al. 2015). A particular case in point is the interpretation of probability distributions by users of climate models (Stephens et al. 2012).

Similarly to the analytic-deliberative model, I draw from the deliberative democracy theory to justify the use of a combination of valuation methods; and from the functional approach to consider both local and expert knowledge in the deliberative exercises. The approach taken here, however, deviates from the analytic-deliberative approach in the sense that it is driven by a group of researchers, does not directly feed into a decision-making process, and crucially, there is no element of seeking group consensus. As such, the participatory process presented here is a representation of an early-stage citizen engagement in the policy cycle, where local policy-makers are not yet formulating a local-level adaptation strategy or adaptation options to be analysed or discussed.

1.3 Research questions

My PhD research investigates the methodological issues of citizen engagement in the context of adaptation governance on local scales. Through interview and workshop engagement with citizens and other stakeholders living and working on the shores of the Inner Forth estuary in central Scotland, I address the following three research questions:

RQ1. In what way do the existing governance structures support shoreline adaptation strategies in the Inner Forth?

RQ2. How does framing shape the outcome of valuation?

RQ3. How does deliberation shape the outcome of valuation?

1.4 Thesis structure

Chapter 2 lays out the key methodological aspects of each research stage, by identifying the most important decisions and their implications for the research.

Chapter 3 *"Hold the line or give in to the sea? Governance and sea level rise in the Inner Forth, Scotland"* adds to the body of literature describing the norms, attitudes and engagement of

citizens and other stakeholders in adaptation, using a governance lens of local-scale social dilemmas (RQ1).

In Chapter 4 (*"Participatory integrated valuation of ecosystem services with citizens in the Inner Forth, Scotland"),* I examine how the pre-defined concept of value (e.g. contribution towards a policy goal) and the associated value framing shape the valuation outcome. Here a multidisciplinary line of valuation methods is used to compare the outputs of different value framings (RQ2).

Chapter 5 (*"Deliberative framework for addressing awareness gaps in environmental valuation: Choice experiment with citizens in the Inner Forth, Scotland"*) examines the issue of knowledge gaps by developing a deliberative framework that explicitly identifies awareness gaps and differentiates between local and expert knowledge. The framework is used to test the impacts of deliberation on participation outcomes (RQ3).

Chapter 6 concludes this thesis by discussing the findings of participatory valuation in the broader context of citizen engagement in adaptation governance; the shortcomings of the methodology; and the implications for future studies using participatory valuation tools.

Chapter 5 is supplemented by six appendices to present the details of identifying awareness gaps in the deliberative framework (Appendix A), the Talking Forth workshops (Appendix B), the choice experiment (Appendix C), who attended the workshops (Appendix D), what participants discussed during the deliberative interventions (Appendix E), and what factors motivated their choices in the choice experiment (Appendix F).

CHAPTER 2

Methodology

This chapter outlines the rationales for the most important choices that underpin the methodology and describes the collaborative choreography for the research activities. Based on my observations throughout this process, I will discuss how the collaborative research created spaces for reflexivity, consequently shaping the positionalities of the researchers involved.

The main phase of this research consists of four research activities (M1-M4 in Figure 1). I address the three research questions through different combinations of the research activities:

- The first question (Chapter 3) is explored through stakeholder interviews (M1), citizen workshops (M2), and a follow-up focus group (M3) with the workshop participants. This question is partly based on secondary analysis of stakeholder interviews that were primarily produced for Pontus Ambros' MSc project (Ambros 2016).

- The second question (Chapter 4) is explored in the citizen workshops (M2).

- The third question (Chapter 5) is addressed in citizen workshops (M2) and face-to-face citizen interviews (M4) in Alloa.

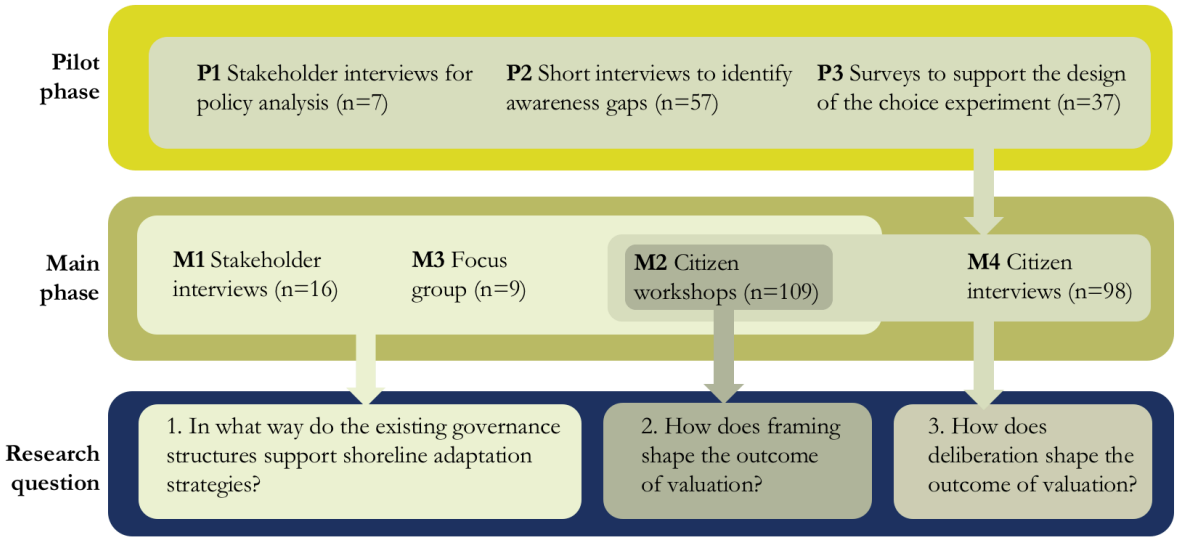

Figure 1. The research presented in this thesis is produced through three pilot activities (P1-P3) and four main activities (M1-M4). The sample size for each activity is indicated in brackets. Each research question is addressed through a combination of different activities.

In addition, there were three pilot research activities that directly informed the design of the citizen workshops and citizen interviews: four informal meetings with seven local stakeholders involved in environmental policy and management (P1); short interviews to identify awareness gaps amongst citizens (P2); and surveys to inform the design of the quantitative valuation instrument (P3) that is a central part of the citizen workshops and interviews.

Here I explicitly reject the positivist research paradigm of 'objective reality' (Popper 1963; Bisaro et al. 2018) in two ways: by setting out my ways of reflexivity during the research; and by beginning to unravel how my own and the 24 other researchers' value positions have shaped the research process. The purpose of this is to point out the key motivations and interests that have shaped the research. Reflexivity, the deeper scrutiny of how the socio-cultural circumstances influence the production and outcomes of research (Fazey et al. 2018), is a central requirement in achieving validity in constructivist and critical schools of social research (Waller et al. 2016) with the potential to enhance the researchers' ability to gain insight (Fazey et al. 2018). The reflexive scientist intentionally zooms in on her own normative orientation and the prevailing power dynamics (Wittmayer and Schäpke 2014). In this view, as articulated by Finlay (2002), the research

process is 'co-constituted' by the researcher, the participant and their relationship. The ways of reflexivity I set out are not exclusively a practice of reflexivity but also of reflection. The latter is more focused on other than self and often retrospective (Finlay 2002). As such, I adopt a pragmatic view of reflexivity where its practice is seen to sit on a continuum with the practice of reflection.

I produced this research together with 24 other researchers who all have influenced the production of this research. Although I am the lead researcher and hold ultimate responsibility for the choices made during this research, this chapter will often use "we" instead of "I" as all important decisions were deliberated amongst the group of researchers involved. Due to this collaborative nature of the research I have held and moved between several research identities (Silverman 2013), which are essentially clusters of my relationships with the 24 other researchers involved: I am a PhD student of four of the researchers involved; advisor and initiator of four other student projects; research collaborator for seven of the researchers involved; process facilitator together with twelve other researchers; and co-producer of knowledge with two of the conservation professionals involved. The breakdown of the relationships does not add up to 24 because some of the other researchers also had multiple identities.

The remainder of this chapter has five parts. I begin by disclosing not only my own positionality, but also the broader positionality of the other 24 researchers who have shaped this research. Next, I justify the most important choices and implications of the research design and sampling strategy. Then, I outline the rationales and collaborations for the seven research activities. This is followed by an overview the major ethical considerations during this research.

2.1 Positionality disclosure

My positionality

I am a female originally from Finland and have lived in Scotland for most of my adult life. Being foreign was never a source of discomfort during the research process and I always felt like a welcome 'outsider' in Alloa. Having studied Ecological Science as my undergraduate degree I often leaned on my identity as an ecologist in the conversations with the participants to explain my interest in their views about their local shoreline and wetland restoration. In my personal life, I live downstream from the Inner Forth on the southern shore of the outer Firth of Forth in the port of Edinburgh, Leith, which has a rich history of maritime industry, slum clearances and more recently urban regeneration, resulting in a mixed social fabric of housing, similarly to that of Alloa.

Positionalities of the researchers involved

Numerous circumstances (gender, education, race, nationality) influence the positionalities of a researcher (Bourke 2014) that can create tensions in the research process. What required most effort in the collaborations of this research were the differences in professional roles and related goals. Cheng and Randall-Parker (2017) set an in-depth example of how professional differences between an academic and a conservation practitioner impact co-production of knowledge; here I will adopt a similar outlook to reflexivity by examining positionality in terms of the different roles and identities we held as researchers. More detailed examples will follow as I describe the data collection: for now, I will provide a distinction between knowledge-driven and process-oriented researchers, in light of the discussions in sustainability science on the epistemological tensions between these research modes (e.g. Miller et al. 2013).

- Eleven of the researchers (including myself) had 'descriptive-analytical' (Miller et al. 2013) **knowledge-oriented roles** where their primary goal as a researcher was to contribute towards knowledge production (Pohl et al. 2010). The rationales for knowledge-production were varied: to advance academic understanding and publish in their field of research, to receive an academic degree or to complete a data-focused task as part of their contract. Depending on the disciplinary orientation and

article they were contributing to, the knowledge-oriented researchers held different epistemological postures (Pohl et al. 2010).

- Fourteen researchers had **process-oriented** roles (Wittmayer and Schäpke 2014; Pohl et al. 2010) where the main goal was to design or complete a citizen engagement activity or task. For the process-oriented researchers, the focus was more on achieving good facilitation rather than on the outputs (Pohl et al. 2010).

The most important moments of reflexivity in this research are in the spaces created by collaboration, and as a result, it is largely a co-product of collaborative research. Similarly to Cheng and Randall-Parker (2017), the collaborations involved many situations where I had to work though differences to adjust the collaboration. These moments of friction between the different identities were, however, peaks of reflexivity that shaped the positionalities of the researchers involved, particularly for those who have engaged in multiple activities. In addition to these unintentional reflexive practices, I intentionally created 'mixing-points' between the roles of the early-career researchers (with more 'hands-on' roles) and senior researchers (with advisory roles). For junior researchers, I held phone calls and took time to discuss the research after a day of data collection to enable learning and subsequent adjustments to the research production. For senior researchers, I created opportunities to gain more practical experience by offering them roles in e.g. taking notes in the workshop.

Mauthner and Doucet (2003) describe how institutions in which the research is embedded shape the choices researchers make. Here the most important institutional context is the OPERAs project, the EU 7th Framework Programme 'Operational Potential of Ecosystem Research Applications'. The main goal of OPERAs is to apply the concept of ecosystem services in practice in 12 locational or thematic exemplars across Europe. This shared objective and institutional setting provided not only a platform for producing collaborative research; the ecosystem services conceptualisation of nature, and its relationship with society, also provided a shared ontological and axiological starting point. The emphasis here is on *starting point*: in practice, the collaborations involving researchers from various disciplines as well as non-academics do not have a shared philosophical

posture, which is a common characteristic in ecosystem services research as pointed out by Ainscough et al. (2018). The main shortcoming of the institutional context of OPERAs, and the associated ontological model of human-nature relationship has implications for the capacity of this research to capture less tangible understandings such as the aesthetic and spiritual models (Cooper et al. 2016). Reasons for this limitation include the ontological posture of humans being external to nature, instead of being immersed in nature (Cooper et al. 2016).

2.2 Research design and sampling

The research design combines elements of triangulation, embedded design and sequential approaches to mixed method research (Creswell and Plano Clark 2007):

- A **triangulation approach** refers to the use of multiple methods to develop a more extensive understanding of a topic (Straits and Singleton 2011). Firstly, I adopted a triangulation approach to compare and contrast the attitudes of citizens (M2-M4) with the perceptions of the other stakeholders (M1) to achieve a more rounded view of the local-scale adaptation dilemmas in the Inner Forth (RQ1). Quantitative methods were used with citizens to attain the overall pattern of preferences from a relatively large sample of demographically representative groups, whereas more in-depth qualitative enquiry was possible with the relatively small group of stakeholders interviewed. In contrast to the classic model of triangulation (Creswell and Plano Clark 2007), the results were converged only at the interpretation stage of the research by qualitatively comparing the differences. Secondly, I used triangulation to compare the impact of the workshop format (M2) with a short interview format on the values elicited (M4) to add to the understanding of how deliberation shaped valuation outcomes (RQ3).

- The knowledge produced through citizen engagement (P2-P3, M2-M4) is primarily based on a **quantitative research design with embedded qualitative methods** (e.g. Creswell and Plano Clark 2007). In this embedded design, both data are collected at the same time, however, the quantitative component is dominant. The main rationale for framing the methodology based on the quantitative enquiry is to quantify

the impact of deliberation in the workshops (RQ3). The purpose of the qualitative enquiry was to examine the process of deliberative interventions (RQ3) and answer parallel research questions (RQ1-2) based on the tasks completed during the deliberative interventions.

- **A sequential design,** consisting of multiple phases (Creswell and Plano Clark 2007), was adopted to pursue an extensive pilot study. The goals of the pilot were to design the quantitative valuation instrument and to ensure that the overall enquiry was appropriate given the social considerations in the area. Quantitative (and predominantly quantitative) research designs are less flexible compared to qualitative research (Ritchie and Lewis 2003) in the sense that no major adjustments to the instruments of enquiry can be made during data collection.

Limitations of the qualitative enquiry

The depth of the qualitative enquiry was limited for both the stakeholder interviews (M1) and the citizen engagement (M2-M4). The stakeholder interviews were based on secondary analysis (Ritchie and Lewis 2003), and as I only participated in one of them, my observations and understanding of the non-verbal aspects, and the context in which they took place, are limited. For the citizen engagement, framing of the methodology according to the quantitative enquiry limits the depth of qualitative understandings in three main ways.

First, the depth of qualitative enquiry is limited by the entirely **artificial research design** in which data is 'generated' in the arranged settings of workshops, surveys and interviews, and involves hypothetical or self-reported measures of behaviour instead of true behaviour. In addition, the enquiry is experimental through the measurement of impacts of deliberation on people's preferences using a three-stage quantitative instrument (choice experiment). This epistemological stance is a contrasting approach to 'naturalistic enquiry in the real world' (Ritchie and Lewis 2003) that typically characterises qualitative research (Harding 2013).

Second, the depth of the qualitative enquiry to "see through the eyes of others (Ritchie and Lewis 2003)" is limited by the **structured nature of engagement** with the participants. The qualitative enquiry is conducted in parallel with the quantitative enquiry: for example, participants are asked to estimate frequency of visits to a certain green space, and then asked why they visit the place. Furthermore, the interviewers and workshop facilitators played an active role in moving through the tasks, leaving less flexibility for the participants to direct the discussion. In practice, however, there was space for the participants to discuss their experiences and thoughts spontaneously. In situations where the interviewee or workshop participants expressed a desire to direct the conversation, the interviewee would not impose the structure on the participants but enter a qualitative inquiry about the topics the participant wished to discuss.

Third, the depth of qualitative interpretation was limited by the **analytical framework** that is not focused on understanding individuals' world views. Instead, this work seeks to gain an impression of social value patterns over relatively large group of people, instead of the qualitative approach of reaching an in-depth and holistic understanding of the views and stories of any single individual (Harding 2013). This methodological individualism applies to both the qualitative and quantitative components of the analysis in the sense that attributes measured (quantitative) or individual perspectives (qualitative) are not explicitly examined against the social and biophysical conditions (Given 2008). Furthermore, the analytical framework was pre-determined based on the research questions and therefore primarily deductive, which is the preferred mode when the research builds on existing knowledge and the goal is to test theory (Roller and Lavrakas 2015). For most analyses, the main themes were pre-defined based on "imposed a priori categories and ideas" (Ritchie and Lewis 2003) set out in the framings of Chapters 3-5, and largely derived from the extensive pilot activities. Achieving a more in-depth understanding of participants' world views would have required a more flexible and qualitative analytical framework of induction where open-ended coding is used to identify themes from the data itself (Keske et al. 2011). Within the primarily deductive analytical framework, however, there was space for induction in the sense that emerging important and interesting themes were raised during analysis, either because they added a previously

overlooked dimension of the research theme, or it was necessary to produce a balanced understanding of participants' viewpoints.

Sampling scheme

The goal of the sampling scheme was to achieve a demographically representative group of residents living in the villages and towns adjacent to the Inner Forth shore. The sample sizes for the citizen engagement activities (apart from M3) were relatively large and randomly selected, in contrast with qualitative research that often involves smaller samples selected based on key criteria (Ritchie and Lewis 2003). The sampling frame, i.e. the people from whom the sample was actually selected (Straits and Singleton 2011), were pedestrians on the high streets of Alloa during week days and Saturdays (10am-3pm). Participants were recruited by unselectively stopping pedestrians in the above-mentioned places and times. We felt that this face-to-face recruitment helped to maximise response rate, as this approach commonly leads to higher response rates than over mail or internet (Straits and Singleton 2011).

2.3 Pilot data collection

Stakeholder interviews for policy analysis (P1)

The formal goal of these four initial meetings with seven different local professional stakeholders (June – August 2014) was to understand the policy context of shoreline management in the Inner Forth. Notes of the main points from each meeting were produced but not systematically analysed. This step of 'defining and laying out the problem space' is the first guiding principle for ecosystem services applications according to Jax et al. (2018). These meetings helped to confirm that the policy issues in focus (shoreline adaptation and the nature-based solution of managed realignment) were locally appropriate. More importantly, I decided to focus on citizen engagement because the stakeholders engaged felt it was an aspect of shoreline management that had received little attention in shoreline planning and management in the Inner Forth. In particular, the stakeholders interviewed had concerns, but little information, about the public's attitudes

towards such adaptation options such as managed realignment. As such, these meetings reflect the epistemologically pluralistic outlook of my research (Ainscough et al. 2018) in terms of seeking non-academic knowledge to develop the research. Although these insights were useful, the most important outcomes were how they shaped my positionality both as a PhD student as well as in producing knowledge with non-academics:

- The meetings, which were also attended by my two primary supervisors, developed my role as a **PhD student**. We felt it was beneficial for the supervisors to engage more closely in the beginning of the research, as I had little experience in stakeholder engagement in research. The shared experience helped the supervisors share more implicit knowledge of stakeholder research based on their observations during these meetings. Furthermore, it helped to build a shared understanding of the local area.

- The meetings provided the foundations for a number of activities that shaped my role in **co-producing knowledge with non-academics**. Two of the local professional stakeholders working for an environmental charity (Royal Society for Protection of Birds) and a government agency (Scottish Natural Heritage) joined a small steering group that we set up to meet two-three times per year to discuss plans and lessons learnt and help the conservation practitioners to reflect on the relevance of the research for their work. Some of the joint activities with these local practitioners included joint presentations in the ialeUK Seascape conference I organised in 2015, as well as the seascape session in the ialeUK conference in 2017. One of the steering group members helped to take notes in the citizen workshops (M2); another member invited me to join a field day for conservation professionals to talk and facilitate discussion on citizen engagement in conservation. Towards the end of the research, the steering group jointly presented and discussed the research in an OPERAs research dissemination event in 2018. Furthermore, we jointly organised a citizen event to share the research findings, yielding 53 participants from the local area.

Short interviews to identify awareness gaps (P2)

I led the co-design of these short interviews with a multidisciplinary team of three collaborators from Lund University Centre for Sustainability Studies, Institute for Environmental Studies (VU Amsterdam) and School of Geography, Planning and Environmental Policy in University College Dublin. I carried the interviews together with three postgraduate students in June 2015.

The formal goal of the short interviews was to support the design of the valuation methods for the main phase: what does the average resident know about the shoreline, what do they care about, and what framings and language do they use for talking about their local landscape? More specifically, these interviews helped to determine the scope of the socio-cultural valuation methods described in Chapter 4 (RQ2), and they formed the first step of the deliberative valuation framework developed in Chapter 5 and Appendix A (RQ3). As such, they helped to ensure that the "concepts and language are adapted to the specific situations and stakeholders", one of the guiding principles for ecosystem services applications according to Jax et al. (2018). The format varied from a very short survey to a semi-structured interview, depending on how much time the participant was willing and able to contribute. Whereas environmental economists usually rely on focus groups to inform the design of quantitative valuation instruments (Keske et al. 2011), I decided to use shorter engagement format to maximise the response rate and ensure that the participants were as representative of the average resident as possible.

The quantitative data, consisting of variables from a statement scoring and pebble distribution exercises, were analysed and visualised using descriptive statistics and bar plots. The qualitative data, consisting of notes from the open-ended questions, were digitised and compiled into summary sheets included in Appendix A. The scope of the valuation (RQ2) and knowledge gaps (RQ3) were determined based on a qualitative assessment of both quantitative and qualitative data.

In terms of positionality, the interviews shaped my role as a process facilitator and a research collaborator in the following ways:

- I established the collaborative 'routine' that I relied on for the remaining research activities (**research collaborator**). This routine generally followed the following basic steps. First, I would write a draft of the research design, usually based on a few calls or face-to-face meetings with my research collaborators. After receiving comments back from my collaborators, I would finalise the plans and carry out the fieldwork. I would then write up the findings and my interpretation of their implications and share it with the collaborators. These frequent conversations and moments of collaborative research design, as a consequence of several interlinked research activities, were the cornerstone of reflexivity for the research. Although many of the 24 researchers involved had relevant expertise, no one was experienced in producing research through deliberative citizen engagement with a demographically representative group. The lack of experience promoted a culture of asking 'obvious questions' during the collaborations: What could we have done differently? What have we learned from today? Has this observation challenged or confirmed my expectations?

- I developed an effective method for engaging people to take part, which I then relied on for the remaining interviews and workshops (**process facilitator**). The goal was to unselectively approach every adult in the same manner as a street fundraiser. We learned that Sundays and lunch hours on weekdays were not productive times to get people's attention, which street corners were the best spots for stopping pedestrians. I learned that people felt more comfortable if I made it clear that it was up to them to decide how much time to spend on the interview. We also learned that it was important to mention the university (a well-known institution) soon after the potential participant stops to learn more. We found participants to be motivated to engage for three main reasons: they felt that the research was concerned with the types of issues they were interested in; they had little prior knowledge but were a curious to learn more; or because they wanted to help out with a student project.

Pilot surveys for designing the choice experiment (P3)

I co-designed and co-analysed the pilot surveys for the choice experiment with an environmental economist collaborator in Institute for Environmental Studies (VU Amsterdam) and carried out the fieldwork together with a visiting MSc student from Lund University Centre for Sustainability Studies in July-August 2015. The goal of these pilot surveys, which are part of Chapter 5 (described in full detail in Box C1 in Appendix C), was three-fold: improve clarity of the choice tasks; determine appropriate levels for the monetary attributes; and generate parameter estimates for the attribute levels to generate an efficient statistical design. The data generated was compiled in a spreadsheet and analysed using an econometric software NGene (version 1.1.1).

The collaborative field work with the visiting MSc student helped me to build experience and skills to initiate and advise other student projects. During this joint field season of surveying in the towns on the shores of the Inner Forth, I helped the visiting MSc student develop a proposal to interview landowners and other relevant stakeholders on their perceptions of adaptation and shoreline management. This initiated an interesting collaboration that allowed us to contrast the perspectives of the public with the attitudes and norms held by more influential stakeholders in adaptation. Since then, I have initiated or helped to develop three more research projects together with other students and early-career researchers.

2.4 Main data collection

Stakeholder interviews (M1)

The design and data collection for the stakeholder interviews was led by the visiting MSc student from Lund University Centre for Sustainability Studies (Chapter 3) as part of his dissertation (Ambros 2016) and the follow-up work he carried out afterwards. My initial role in the project was to support with the design and attend one of the interviews. With the goal of addressing RQ1 (Chapter 3), I later conducted secondary content analysis of the interview transcripts to qualitatively code and describe stakeholders' perceptions and

collaborative practices with regards to adaptation, with input from the visiting MSc student.

Focus group (M3)

This focus group with citizens in Alloa was produced together with a research collaborator from Lund University Centre for Sustainability Studies. The purpose of the focus group was to explore questions of governance in more detail with a small group of citizens who had participated in the citizen workshops. We produced notes of the main points, but the content generated was not systematically analysed, as we felt that the discussion did not yield new insights in addition to the workshop findings. Instead, the content from this focus group helped to contextualise our existing understanding of how citizens perceived local environmental governance and shoreline adaptation.

Citizen workshops (M2)

Five citizen workshops were organised with the help of a large group of researchers in October 2015 – February 2016. I co-designed the participatory process with the support of one of primary supervisors and a social scientist working for an enterprise (Prospex) whose role in OPERAs was to provide professional advice on stakeholder engagement activities. The groups exercises were facilitated by five postgraduate students in the School of Geosciences who had some or no experience in workshop facilitation. Note-taking support was provided by two of my supervisors, one of the steering group members, a research group member and the visiting MSc student. The penultimate workshop was filmed by two science communicators to produce research dissemination materials (OPERAs 2016).

The workshop consisted of three types of activities: the quantitative valuation instrument i.e. choice experiment (RQ2 and RQ3), mixed method socio-cultural valuation tasks (RQ1 and RQ2), and a mixed method task to deliberate on shoreline governance (RQ1). The choice experiment is described in full detail in the methods section of Chapter 5 and Appendix C; the socio-cultural valuation methods in Chapter 4; and shoreline governance task in Chapter 3.

Data processing involved the transcription, digitation and integration of over 60 hours of group discussion recordings, 60 locational maps, 40 mind maps, 1962 choice cards. The transcripts for each of the twenty discussions were produced over a 11-month period together with an OPERAs research associate and a BSc student for whom it was part of her dissertation project to examine differences in local and expert perceptions of shoreline governance in the Inner Forth. Instead of transcribing all of the discussions in verbatim, we transcribed only sections of the discussion that were required for analysis to address the pre-determined topics. The consequence of this deductive data processing approach was that the content had less influence on the direction of analysis. We felt that this approach was justified because the researchers had a tentative understanding of relevant themes based on the extensive pilot studies.

The data analysis consisted of choice modelling (choice experiment) and content analysis (socio-cultural valuation and deliberation task on shoreline governance):

- Estimation of the **choice models**, an economic stated-preference elicitation instrument, was led by the environmental economist collaborator in Institute for Environmental Studies (VU Amsterdam), with my input particularly on visualising the distribution of individual preferences.

- **Content analysis**, a systematic and process-driven method (Roller and Lavrakas 2015), was applied to analyse the mixed method **socio-cultural valuation tasks**. The transcripts were qualitatively coded to identify and describe citizens' perceptions of nature-based adaptation (RQ1). To compare the impacts of value framings on the valuation outputs (RQ2), I used both thematic qualitative coding and description, and quantitative comparisons and visualisations. The thematic qualitative content analysis (Gomm 2008) was carried out to identify, code and describe themes or features mentioned during each task. The quantitative content analysis covered the locational maps, mind maps and transcripts, and involved counts of frequencies in terms of mentions, reported visits or Likert scores. Where quantitative comparison between the twenty groups across the five workshops (four groups per workshop) was meaningful, descriptive statistics were calculated.

Qualitative differences were visualised Venn diagrams and tables with thematic icons; quantitative differences were visualised using tables, maps, and bar plots.

- **Content analysis** was also used to analyse the **deliberation task on shoreline governance**. First, transcripts were coded qualitatively, to identify comments that describe how citizens feel included in shoreline planning (RQ1). Second, institutions or other drivers of change that citizens mentioned to drive change were identified and coded quantitatively to create a spreadsheet of different drivers of change as rows, and qualitative (illustrative quotes) and quantitative variables (number of mentions and type of impact) as columns. To address RQ1, I created a table to visualise the relative importance of institutions impacting the shoreline. In addition, I completed a complimentary analysis based on the social-ecological systems (SES) framework by Ostrom (2009) to explore the relationships between the drivers mentioned and their relative perceived impact on ecosystem services. I assigned all rows in the spreadsheet a first-tier code according to the first-tier variables in social-SES framework and created second-tier codes inductively to illustrate variety within each first-tier category. This additional analysis (Appendix E) feeds into the description of the deliberative process in Chapter 5.

The design and implementation of the workshops posed the most interesting tensions, but also synergies, between my roles as a knowledge-driven researcher and process facilitator (each role is summarised in Figure 2).

	Workshop design stage	Workshop organisation stage
Knowledge-driven researcher	I designed a highly structured workshop programme to satisfy the knowledge needs required to address different research questions in parallel. This epistemological plurality resulted in tensions with the collaborators who had more specific disciplinary interests.	To ensure all 20 groups systematically complete all tasks in the time available, my main tasks during discussion activities were to manage transitions between activities; ensure that groups had materials for each task; and deal with any emerging issues to minimise the impacts of any disruptions.
Process-driven researcher	I organised training for all table facilitators to create a shared understanding of the programme, and to improve the facilitation guide. Facilitators felt unsure how to provide a more detailed explanation of certain vague terms, such as 'space for nature' and 'green space'. More detailed descriptions of relevant terminology were included in the facilitation notes.	I practiced reciprocity towards the participants by endeavouring to make the event enjoyable and social enough to be worth attending in its own right. In addition, participants were paid a fee to compensate for their time and efforts; and a citizen event was organised to share the research findings.

Figure 2. A summary of my main goals for description-analysis (knowledge-driven) and facilitation (process-driven) during the design and organisation of the five citizen workshops organised in Alloa Town Hall.

In the workshops, the main tension in terms of positionalities was around the trade-off between the ease at which values can be expressed and precision of data collected:

- Asking the participants to provide responses using digital tools (e.g. participatory GIS applications) would have resulted in much more precise and less processing-intense dataset. This, however, would have made the workshop less interactive and accessible for less digitally literate participants.

- Instead of providing the participants with a strict procedure for expressing their values, I allowed for flexibility in the way in which they could answer the questions. They could either annotate features on the paper maps provided or explain verbally; in most cases participants did a combination of both. Less outspoken individuals and highly literate participants used the maps, whereas those who were interested in debate and exchanging views often did not bother writing their points down. This flexibility helped to maintain flow of discussion during group work but made the data processing more laboursome.

There were also synergies in pursuing my goals as a process-facilitator and a knowledge-driven researcher. Our efforts to maximise response rate helped to achieve a representative sample (knowledge goals) and enhance accessibility to all people living on the shores of the Inner Forth (facilitation goals). To achieve this, I chose to organise the workshop during daytime on a Saturday so that people working during office hours could join; and families could make it a 'day out' that children can also attend. Those who were employed in shift work struggled more to fit the workshop in their diaries. If the person was not able to attend the first upcoming workshop date, I offered one of the later upcoming dates, or to contact them by text message in a few weeks' time to see whether they would like to attend at a later date.

Citizen interviews (M4)

I carried out the choice experiment interviews together with three research assistants in November 2015 – June 2016 to compare elicited values between two different valuation formats: individual face-to-face interviews and social workshop settings. In particular, we were interested in whether there was a difference in people's preferences between the interviews and in the workshops before the interventions. The participants were recruited in Alloa to provide a comparable sample with the workshop. The data generated were analysed as part of the choice modelling described for citizen workshops (M3).

The most common methodological question other researchers ask is why we chose to ask people's preferences in a face-to-face survey and not an online survey, which is increasingly commonly used and generally seen to provide satisfactory quality of

responses (Lindhjem and Navrud 2011). Even though an online survey would have produced satisfactory estimates, I felt more confident in the quality of results if I could observe how the participant made their choices. The participant also had an opportunity to ask questions to clarify, and we were able to find out more about the rules people used to determine their preferences by asking them why they had chosen certain questions. The face-to-face format also allowed us to be more flexible by completing fewer choice tasks if the person had limited time available. And more importantly, face-to-face surveys allowed us to conduct a nearly identical recruitment procedure as with the workshops.

The choice experiment interviews were the most static research activity in terms of positionality because the routine of enquiry was built on the experiences of the pilot studies, and all researchers (apart from one of the assistants) had been involved in the citizen workshops (M2). The main tool for practising reflexivity were the train journeys to and from Alloa during which we discussed the experiences and challenges of talking about climate change, wetland restoration, conservation and shoreline management with the 'average person'.

2.5 Ethically important moments

The workshops were a particularly important ethical stage of the research because they were more dynamic and immersive modes of participation compared to individual face-to-face interviews. From an ethical perspective, the main goal of the workshop was to ensure that the participation experience was a safe, transparent and valuable experience. We endeavoured to achieve this through the application of both 'procedural ethics' together with 'practical ethics':

Procedural ethics, as expressed by Guillemin and Gillam (2004), provide a useful engagement point with the guiding ethical principles of research. We built a shared understanding of research ethics between researchers from different institutions by agreeing to consistently follow the Research Ethics Procedure of the School of Geosciences (University of Edinburgh). The research plan was reviewed and approved by the School of Geosciences Ethics Committee prior to data collection. We obtained

informed consent and handled participants' contributions with confidentiality, which are major principles of social research according to Gomm (2008). For the landowner interviews, participants were asked to sign a letter of consent, whereas for the citizen engagement the consent was verbal. For workshop participants, we explained the purpose of the study and what we expected from them both when they signed up as well as in the beginning of the event. We asked the workshop participants to be honest about the questions we ask, take the courage to speak up and share their views during the discussions. It was also reiterated that we audio record the discussions to capture all of the points made during the discussion. For anonymity and confidentiality, we assured the workshop participants that we will not share the tapes with anyone else or associate what the participants say with their name. For the children who took part in the workshop, we did not explicitly seek consent but allowed them to participate in the discussions if they were participating together with their parents. We also obtained permission for photography and filming in the citizen workshops. The photographs of the participants in the publications are included with consent.

Not all ethically important moments can be anticipated or addressed beforehand. Guillemin and Gillam (2004) suggest that reflexivity provides the means for dealing with **situational ethical dilemmas** in research that procedural ethics cannot address. There were several moments of ethical importance that related to my role as process facilitator. I provided additional support for a participant whose mental health issues affected her ability to take part; arranged note-taking help for participants with child-minding duties; and expelled a participant for bringing illegal drugs to the event. I also took the time to chat to interview and workshop participants at the end to ask how they found the experience. The purpose of this was to informally debrief with the participants, which Straits and Singleton (2011) argue to be an essential part of any study dealing with humans. The debriefing is also a reflexive practice for the researcher by providing an understanding of how the participant perceive the research process.

As the research process unfolded there were also ethical challenges that related to my role as a knowledge-driven researcher. The most important of these were the frequent concerns over fracking in the local area that I had initially overlooked. As Jax et al. (2018)

suggest, issues of justice, such as the potential local damage from fracking, are important ethical considerations in ecosystem services research. Fracking was not raised as a major concern amongst the professional stakeholders (P1), perhaps because the national policy developments suggest that there is no immediate likelihood of fracking in Scotland. I felt that the analytical framework for the valuation exercises did not sufficiently capture the emerging concerns about how the private sector governs the shoreline in the area, resonating with Norgaard's (2010) criticism of the ecosystem services concept for its blindness to the need for institutional change. To address this, I allowed more time for the final deliberative exercise on shoreline governance in the last two workshops to better capture these concerns. As a result, I gained a better understanding of what governs the shoreline from citizens' perspectives. I thus share the experience of Mahajan and Daw (2016) who find reflexivity towards emerging ethical conundrums to lead to new understandings of the studied phenomena. Here, I find reflexivity towards my analytical framework to open the door for a more profound understanding of the context in which I examine the methodological issues of citizen engagement in adaptation.

CHAPTER 3

Hold the line or give in to the sea? Governance and sea level rise in the Inner Forth, Scotland

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3.1 Introduction

People have an innate preference to live close to the sea, and the majority of the world's population lives in low-lying areas in coastal settlements that depend on the sea for trade and livelihoods (Small and Nicholls 2003). For centuries, humans have actively transformed coastlines and estuaries by enclosing tidal land for settlements and agricultural purposes (Doody 2004; Agardy and Alder 2005). In modern times, construction of industrial ports and the extension of urban areas in to the sea have continued this process (Rogers et al. 1998; McGranahan et al. 2007). These land claims have led to a significant loss of wetlands, such as salt marshes and mudflats (Mitsch and Gosselin 2007), affecting marine biodiversity and important ecosystem functions that

characterisethese tidal habitats, such as carbon sequestration (Chmura et al. 2003), sediment trapping and retention (Adam 2002), and protection from waves during storms (Möller et al. 2014).

In addition to these longstanding land use changes, anthropogenic climate change is an emerging threat to estuarine ecosystems, most notably due to coastal squeeze (Scavia et al. 2002; Roebeling et al. 2013). Coastal squeeze is a common phenomenon due to sea level rise in areas with developed shorelines, where infrastructure, such as sea walls, stop the intertidal zone from its natural process of moving landwards (Doody 2004). Combined with population growth and urban expansion in coastal cities, pressures exerted on estuarine ecosystems are increasing (McGranahan et al. 2007). As a result, people are increasingly exposed to coastal flooding (Small and Nicholls 2003). This is a global trend, and is particularly pressing in Scotland, where more than 95% of the population live within 50 km of the coast (European Commission 2013) and where coastal flooding and erosion are concerns that require immediate action (UK Committee on Climate Change 2016). Flood damages are expected to cost £200-250 million in Scotland annually in 2016-2021, (ClimateXChange 2016; Pirie 2017), which is 7-8 % of Scotland's education budget in 2016 (Scottish Government 2016b). Coastal flooding is estimated to contribute 21% of the monetary cost (ClimateXChange 2016; Pirie 2017) of flood damages.

There are two main climate change adaptation options for coastal flooding: static and nature-based. The first, more traditional engineering option is the static approach to shoreline defences, where constructed barriers, such as sea walls and piers, protect urban, industrial or otherwise human-used areas from flooding (Zhu et al. 2010). The second option is to restore the wetlands that characterisemany estuarine areas and provide a nature-based coastal flood defence (King and Lester 1995). Wetland protection and restoration can play an essential role in decreasing the risk for coastal flooding in those areas that are most vulnerable to sea level rise (Spalding et al. 2014). The deliberate moving inland of coastal defences such as levees to give more space to the sea, an approach known as managed realignment, has been suggested to be the only viable option in the long term for some coastal areas (Morris 2013). Moving vulnerable settlements and infrastructure

from harm's way would improve coastal defences in the long-term (Esteves 2014) and create habitat benefiting a variety of species (Colclough et al. 2005).

In the United Kingdom, managed realignment is perceived as a sustainable option for coastal management among scholars and policy-makers because it delivers multiple ecosystem functions and related ecosystem services (Milligan 2009; Luisetti et al. 2011; Spencer and Harvey 2012). However, to date there is little evidence whether the 'ecosystem services' conceptualization is being used by policy-makers at the local-level in the practice of coastal management and adaptation.

The planning and implementation of coastal adaptation can be hindered by a multitude of factors related to governance, policy goals and people's perceptions (Ledoux et al. 2005; Morris 2013), as well as economics (Turner et al. 2007), hydrology and ecology (Spencer and Harvey 2012; Doody 2013). Many of these factors can prevent the implementation of managed realignment schemes, although examples of successful managed realignment pilot projects exist in the UK (Midgley and McGlashan 2004). Moreover, managed realignment is increasingly used for coastal habitat compensation in the UK, although it is unclear whether this actually leads to net benefits for biodiversity (Brady and Boda 2017).

Studies by Ledoux et al. (2005), and Wiering and Arts (2006) reveal that managed realignment is perceived as a defeat against the sea and a threat for productive land, particularly in times of climate change and sea level rise when agricultural land is already becoming increasingly scarce. If avoiding a defeat against the sea is a strong cultural norm, defined as "typical or expected standard or behaviour" (Oxford Dictionary 2017a), we argue that it represents a powerful informal institution (Hansen et al. 2014) with implications for coastal adaptation efforts. In principle, institutions are formal elements of governance, such as an established law or an organisation, or an informal element, such as a custom or practice "in the political or social life of a people" (Oxford Dictionary 2017b). Recognising these informal elements of governance, including norms, shed light on why there is reluctance amongst local communities to retreat landward, which may in turn impede the implementation of managed realignment schemes (Ambros 2016; Foster et al. 2013; Luisetti et al. 2011).

Managed realignment is currently under increasing local interest and debate in the case of the estuarine area in the Inner Firth of Forth (hereafter referred to as the Inner Forth), Scotland (Figure 1). Over 50 percent of the former wetlands intertidal area in the Inner Forth has been reclaimed (via land draining and building sea walls) in the last 400 years for farming and industrial uses (Scottish Natural Heritage 2011). Most of the areas that were claimed from the sea were wetlands that are now owned and used by individual farmers and the local authorities. Due to its low elevation, closeness to the sea, climate change and sea level rise, these lands are increasingly vulnerable to coastal flooding. Yet, given coastal development, there is less space to absorb excess water and the damage to property and built infrastructure elsewhere is higher. Locally observed trends in sea level rise in recent decades are already in line with the high emissions scenario (Rennie and Hansom 2011) that projects sea level rise for the Inner Forth region of about 30 to 54 cm by 2080 (central to high-end estimates, Lowe et al. 2009), requiring the Inner Forth, like many other coastal communities, to choose its adaptation pathway: will they hold the line or give space back to the sea?

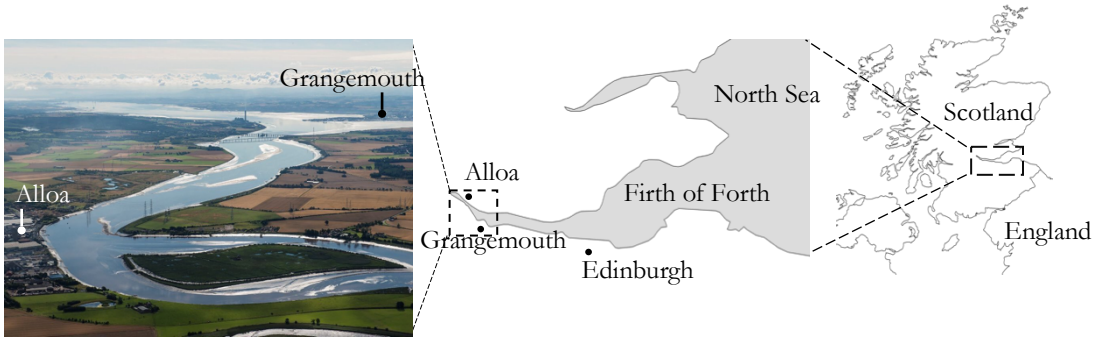

Figure 1. The Inner Forth lies in the upper Firth of Forth (right). The area is characterised by Europe's largest oil refinery complex Grangemouth, small towns such as Alloa, agriculture, tidal marshes and mudflats.

3.1.2 Aims and objectives

Here we investigate how current governance arrangements are aligned to support societal responses to the increased risk of coastal flooding in the Inner Forth. The results of our study can be transferred to other areas of Scotland and beyond, and practically be applied by policy-makers and coastal managers in including deliberative methods and participation of citizens in planning decisions. The following three research questions guide the research on how citizens' and other stakeholders' attitudes, and current stakeholder engagement support coastal adaptation to climate change in the Inner Forth.

RQ1 How do local stakeholders perceive the two alternative coastal climate change adaptation options (static and nature-based shoreline defences)?

RQ2 Which institutions govern the Inner Forth shoreline from a citizen perspective?

RQ3 How does existing stakeholder engagement support climate change adaptation on the Inner Forth shoreline?

3.2 The governance context

A variety of different actors, representing civil society, the government and industry interest groups are key in the governance in the Inner Forth area and coastal management.

At local level, a prominent example is the Inner Forth Landscape Initiative, a partnership that brings together many institutions and organisations, which integrates environmental objectives with measures to improve access, aesthetics, interpretation, cultural heritage and skills, to encourage both ecological and economic regeneration of the area (Inner Forth Landscape Initiative 2014). It involves four local authorities (Falkirk, Stirling, Clackmannanshire and Fife), the Central Scotland Green Network Trust, the Scottish Environmental Protection Agency (SEPA), Scottish Natural Heritage (SNH), Historic Scotland and Sustrans, and strongly emphasizes the involvement of stakeholders and local people (Kenter 2014).

Nationally in Scotland, the two government agencies, SEPA and SNH, are responsible for flood protection and nature conservation respectively and providing legal advice to existing or new legislation. In addition, both organizations also have an advisory role to other public stakeholders, such as local authorities. The local authorities are in turn obliged to comply with national legislation and European Union directives, for example the Flood Risk Management (Scotland) Act (2009), Climate Change (Scotland) Act (2009) and the EU Water Framework Directive (2000/60/EC). The implementation of these legislations should, in principle, be reflected in the local authorities' management plans. However, due to the differences in geography, development, interests and political leadership, the local authorities comply with legislation in separate ways.

The statutory process of coastal adaptation has been set by The Flood Risk Management (Scotland) Act 2009. The act includes several measures for flood risk management in Scotland, for instance, the preparation of local flood risk management plans to fulfil the requirements on a local level (Scottish Government 2016c). The plans for the Inner Forth were recently published as part of a plan for the entire Forth Estuary (City of Edinburgh Council 2016). The plan does not include managed realignment or other nature-based approaches to flood management in the Inner Forth, despite numerous sites being recognized as potentially vulnerable to coastal flooding, and the presence of several sites that would be suitable for managed realignment. However, the document does indicate plans to assess opportunities for natural flood management measures in the future.

Many other national policies also directly impact coastal management. In Scotland, landowners have the primary responsibility to protect their land and property, and there are no incentives for land use or management that would improve flood safety in vulnerable areas (Scottish Government 2014). The current coastal defence strategy is almost solely based on static flood defences in the form of sea walls. These defences were introduced between 400 - 40 years ago, as wetlands were drained and converted for agricultural and industrial uses, protected by seawalls (Smout and Stewart 2012). For privately owned land, such as agricultural land adjacent to the sea, the responsibility for flood protection lies with the landowners, mainly via and maintaining existing sea walls. Under the Coast Protection (UK) Act (1949), landowners have been given the right and

duty to maintain these sea walls and keep a static defence towards to sea. Thus, landowners naturally have a high stake with regards to future floods, and should, in principle, have a high interest in measures that increase flood protection.

On the European level, the existing institutional arrangements, such as rights and responsibilities of different institutions involved in marine and coastal management are often complex and unclear. For instance, analyses carried out by Boyes and Elliot (2014; 2015) found that marine policy in the European Union is characterized by a multitude of actors and authorities, resulting in a confusing governance context. How the UK's decision to leave the EU will affect policies that have been designed at the EU level is an important yet open question for coastal management. For example, it is not yet clear whether and how policies are transposed to national level, and whether the downscaling of policies will convolute responsibilities in coastal planning and policy.

3.3 Methods

To collect data to address the three research questions, we conducted 16 semi-structured interviews with local land-owners, farmers and locally active organisations who are involved in coastal adaptation in the Inner Forth. Furthermore, we engaged with a total of 109 citizens living in the Inner Forth through five workshops (Table 1).

Semi-structured interviews (Babbie 2013) of approximately 60 min were conducted with relevant stakeholders (Step 2, Table 1) in February-March 2016 and October 2016. In total, we interviewed sixteen stakeholders, including seven farmers owning land potentially subjected to managed realignment, representatives from three out of the four local authorities, two government agencies (Scottish Environment Protection Agency) and Scottish Natural Heritage), an estuary partnership organisation (Forth Estuary Forum), the locally active conservation charity Royal Society for the Protection of Birds (RSPB), one trust and one agricultural estate bordering the shorelines of the Inner Forth. Although we identified 16 farmers as potential stakeholders, nine farmers could not or did not want to be interviewed. The fourth local authority, Stirling, was not interviewed because they do not own or manage any coastal land holdings.

We organised five workshops with a total of 109 citizens in October 2015 – February 2016 in Alloa, a town on the shores of the Inner Forth. Participant recruitment and workshop programme are summarised in Steps 3 and 4 in Table 1. The full details of citizen engagement are described in Chapter 5 and Appendix B. In total, we have collected data from twenty break-out groups (four groups in each workshop) to analyse the main points that were raised during the discussions.

Both the stakeholder interviews and the citizen workshop discussions were recorded, transcribed and the content was analysed to address the three research questions, which are described next.

<table>
<tr><th>Research steps</th><th>Activity</th></tr>
<tr><td>Step 1
Stakeholder mapping</td><td colspan="2">Identified the 16 landowners around the Inner Forth using a land registry and local contacts. Stakeholders without landholdings were identified through a stakeholder mapping exercise where stakeholder influence and interest were estimated, thus providing an overview of the most important stakeholders (Durham et al. 2014).</td></tr>
<tr><td>Step 2
Individual stakeholder interviews</td><td colspan="2">Different interview questions were asked to stakeholders who manage land (farmers, RSPB, trust and estate) and those who do not (government agencies and local authorities):</td></tr>
<tr><td></td><td><u>Farmers</u>
We asked about their current land use and management, how they were economically dependent on the land, and their attitudes and strategies to deal with climate change (RQ1). We also asked about their involvement in local planning and decision-making (RQ3).</td><td><u>Local organisations not managing land</u>
We asked about their knowledge and actions on climate change adaptation and their coastal adaptation strategies (RQ1); and how they involve local stakeholders in coastal planning (RQ3).</td></tr>
<tr><td>Step 3
Recruiting citizens to participate</td><td colspan="2">Workshop participants were recruited in person by approaching pedestrians in the Alloa Town centre, to achieve a representative sample of the population living in Clackmannanshire, the municipality area in which Alloa sits.</td></tr>
<tr><td>Step 4
Deliberative citizen workshops</td><td colspan="2">The workshop lasted for five hours and consisted of presentations from researchers on coastal change and land-use planning in the Inner Forth (20 min), followed by individual tasks to elicit citizen preference for coastal planning (40 min); and concluded with a two-part discussion to share knowledge and views on local areas and planning in groups of 3-7 participants (180 min).
Before the group discussions, the two options for coastal adaptation on the shoreline (static and nature-based) were explained in plenary to all participants.</td></tr>
<tr><td></td><td><u>The aim of the 1st discussion:</u>
Understand citizens' views on static and nature-based shoreline defences on the shoreline (RQ1):
1. Facilitators placed a large map of the sites where nature-based shoreline defences could be created by restoring wetland, and asked the group to share their views on the idea of wetland restoration to prompt knowledge sharing and discussion on the local shoreline and its future
2. Participants were then given a list of estuarine ecosystem services and biodiversity benefits that would be impacted by the nature-based shoreline defences, such as flood regulation and aesthetic impacts, and asked to consider which of them they wanted to change</td><td><u>The aim of the 2nd discussion:</u>
Identify which future drivers of change citizens perceive to impact the shoreline (RQ2):
3. Facilitators asked the participants to list and discuss which drivers of change they thought would impact the shoreline areas in the Inner Forth in the future, and consider which of the drivers they were most concerned about
4. The facilitator wrote down drivers mentioned on a mind map</td></tr>
<tr><td></td><td colspan="2">A citizen event was organised to share and discuss the research findings</td></tr>
</table>

Table 1. Overview of the methodology for the stakeholder interviews and citizen workshops in the Inner Forth, Scotland. The corresponding research questions for each activity are indicated in brackets (RQ)

3.3.1 How do stakeholders perceive static and nature-based shoreline defences? (RQ1)

From the interview transcripts, comments relating to either static or nature-based shoreline defences were identified and assigned to one of the two flood defence approaches. We also identified all motivations for their positions on static and nature-based shoreline defences, to identify common reasons or norms supporting or hindering coastal adaptation. Quotations are included to illustrate findings, but these are not attributed to stakeholders to avoid revealing their identities.

For the citizen workshops, transcripts from the first part of the discussion, which is described in Step 3 in Table 1, were analysed to identify comments with regard to the potential sites for managed realignment, and motivations for supporting or opposing wetland restoration in the Inner Forth.

3.3.2 Which institutions govern the Inner Forth shoreline from a citizen perspective? (RQ2)

To understand citizen's perceptions of shoreline governance, transcripts from the second discussion-based exercise (Step 4, Table 1) were analysed to identify those institutions the workshop participants perceived to govern the shoreline areas in the Inner Forth, and frequency of mentions was counted from the mind maps. The discussion in most groups, however, broadened in scope to cover issues beyond immediate shoreline areas. To maintain focus on coastal adaptation, we excluded institutions that only relate to issues beyond the shoreline.

3.3.3 How does stakeholder engagement support shoreline adaptation in the Inner Forth? (RQ3)

For stakeholder interviews, mentions of collaborations and interactions with other stakeholders regarding coastal management were identified to understand how stakeholder engagement currently supports coastal adaptation.

For citizen workshops, we identified examples of how citizens felt they were informed and included in local planning and policy. Here too, quotations are included to illustrate findings, but these are not attributed to individuals to avoid revealing their identities.

3.4 Results

3.4.1 How do stakeholders perceive static and nature-based shoreline defences?

Based on their land ownership and existing property rights and responsibilities, the private landowners, farmers and the private estate had the highest stake in decisions regarding shoreline defences, whereas the RSPB and the estuary partnership had the lowest stake (Figure 2). The RSPB and Clackmannanshire residents were the most supportive of nature-based shoreline defences, whereas the private landowners, farmers and the charitable trust were the only stakeholder groups that did not support nature-based defences (Figure 2). The stakeholder motivations and stakes in shoreline defences are described in more detail in the following.

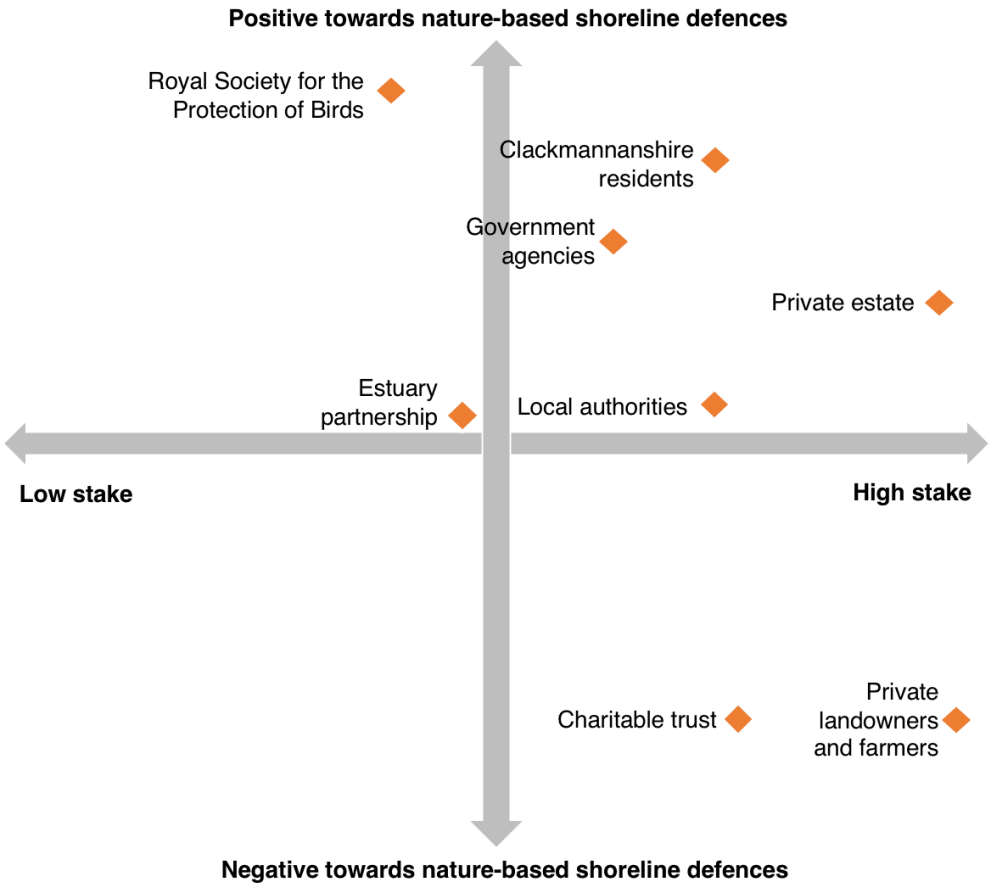

Figure 2. Stakeholder attitudes towards and stakes in managed realignment, drawn from the content analysis of the sixteen interviews conducted, and the citizen workshops in Alloa Town Hall

Farmers and locally active organisations (RQI)

The seven farmers we interviewed (Figure 3), who manage most of the land suitable for creating nature-based shoreline defences, prefer static defences, whereas the private estate (largest landowner in the area) is supportive of nature-based defences. Farmers attributed their reluctance to managed realignment to three main reasons: the effects on their land

and resulting economic losses, the desire to maintain their agricultural heritage, and their awareness of unsuccessful nature-based flood risk management schemes in the area.

Figure 3. We interviewed seven farmers and eleven other stakeholders across the Inner Forth area and held workshops with 109 citizens in the Alloa Town Hall. Photography permissions granted by participants

Sustaining livelihoods was the main reason the farmers preferred static defences, as managed realignment would result in the loss of land area where they could grow crops, and consequently loss of crop yields. Agriculture generated 25-100% of the income (67% average) for the seven farmers we interviewed. For the private estate, the "main aim is trying to preserve income from the land: if it is under water, it would probably not be very much land". This motivation was also linked to family heritage, for example, one of the farmers (interview on 01.03.2016) mentioned how it was important to "make a living and leave something for the boys to carry on with, I have two sons". The farmer interviewed on 23.02.2016 was motivated to farm "to progress so the next generation can carry on". Concerns over past experiences, for example in the Skinflats nature-based flood management scheme, where an engineering fault resulted in erosional impacts on adjacent farmland, were also reflected in their reactions to managed realignment: "No, I don't think it would do any good for anybody, we have seen how bad it can get (farmer interviewed on 01.03.2016)".

Representatives from the three local authorities (Clackmannanshire, Falkirk, and Fife), government agencies and the RSPB are mainly supportive of managed realignment (Figure 2). Although none of the three local authorities we interviewed were opposed to

managed realignment, they all prescribe to a static shoreline defence approach in their coastal management plans. Further, two local authority representatives noted concerns about the trade-offs arising from nature-based shoreline defences and had rejected managed realignment proposals in the past, whereas the third local authority was not implementing any managed realignment schemes in the Inner Forth area. The government agencies were supportive of managed realignment: the first representative, however, noted that their support depended on careful planning, alignment with other coastal development goals and flood protection, whereas the second representative appreciated its potential for nature conservation.

The locally active organisations we interviewed describe three types of norms that contradict managed realignment in the Inner Forth. These norms relate to decision-making, their relationships with the private landowners, and preferences for land management approaches (Table 2). The first type of norm relates to their principles of evidence-based and economically rational decision-making, which are demanded by the broader economic and political systems in order to justify decisions. These norms were exemplified by concerns over the maintenance costs of nature-based defences, and a notion that other social priorities (e.g. need for housing) are more important. The second type of norm, as described by one local authority representative, related to concerns that creating nature-based defences would compromise their relations with the local farmers. The third type of norm was directly linked to attitudes towards nature-based land management, some of which were justified by the erosional issues in the Skinflats scheme mentioned earlier.

Norms hindering nature-based shoreline defences	**Illustrative quotes from interviews with locally active organisations in the Inner Forth**
Decision-making based on economic rationality and locally-derived evidence	Willingness to support managed realignment is limited by lack of urgency ("[Will sea level rise be a problem?] Not in the short term. Not during the time I will be working[1]") and lack of local empirical evidence of current sea level rise in the Inner Forth ("I haven't seen any empirical evidence of the Inner Forth, but there is national evidence of sea level rise of 1-2 mm of per year[2]") Concerns that poorly designed schemes can lead to increased maintenance costs (". . . [if] it ends up costing more in maintenance than if you just had let it crumble naturally, I think [that] is a bit of an issue[3]"), and conflict with economically rational decision-making from both policy-maker perspective ("If an area had strategic value for development, say industrial development, then we would not be able to do a lot of biodiversity work on that. The economic argument would take precedence[1]"), as well as landowner perspective ("It is hard to sell the idea of giving up land when land is having a financial value[4]". Willingness to manage flood risk only if there is evidence that it is affecting considerable numbers of residents rather than few: "If there were 500 houses, we would be interested. But because there is maybe 10 or 20. . . [suggests they do not have a responsibility for managing flood risk][1]"
Emphasis on sustaining good relations with landowners and farmers	Hesitance to support managed realignment schemes, because it would confront the views of the local farmers, who claim that a recently implemented natural flood management scheme had caused flooding and drainage issues further upstream ("It would have to be proven to us that it will not flood somewhere else[1]")
Preferences for land management approaches	Preferences against and negative past experiences with schemes that let the site turn to its natural state without active management or breaching a sea wall ("It is kind of best to let it go to a natural state, rather than actively managing it with sluices and that[3]"; "If someone would suddenly come up with the idea, we would not do a managed realignment in another area[1]")

Table 2. Three main sets of norms identified from interviews with seven locally active organisations that influence their position towards nature-based shoreline defence schemes in the Inner Forth, and examples emerging from the interviews

[1] 20.10.2016 (First interview)
[2] 20.10.2016 (Second interview)
[3] 21.10.2016
[4] 25.10.2016

Deliberative citizen workshops (RQ1)

At the workshops we carried out with local citizens (Figure 3), we formed twenty groups of 3-7 people for discussion. The workshops revealed that their knowledge of the shoreline areas was limited, and they were unfamiliar with a majority of the sites where managed realignment is proposed. Only two out of the twenty groups explicitly mentioned the agricultural production currently occurring on potential sites for managed realignment. Some participants responded to the information provided in the workshops by noting that the Inner Forth might flood more frequently in the future, but only two out of the 109 participants indicated that they had been aware of the flood risks before the workshops.

Despite the limited knowledge of the local shoreline, citizens in the workshops discussed several reasons why they support wetland restoration (Figure 2). They noted how keeping "more nature in the area, [so] it would help with many of these other things. When it rains, there is somewhere for it [the water] to go (10.10.2015)". Many participants said that they "didn't know wetlands slow down flood water, or that it would remove pollutants, that is quite surprising to me, but blatantly obvious (24.10.2015)", and that their appreciation for wetlands had increased during the workshop as they gained more knowledge:

> *The wetlands, from what I have learned, are the most important feature on the banks of the river, and they should be increased, or at least, maintained, as well as possible. Just to broaden up the benefits of them, and the effects that not having them, or having less of them, could have on the community (workshop participant, 14.11.2015)*

It was also recognised how nature brings emotional and physical wellbeing, such as the "sounds and the smells, [which] are all important, for providing the natural experience. When you are standing by the water, the smell of the flora, it is part of the experience of being part of these areas (14.11.2015)". One participant described the importance of spending time outdoors for her wellbeing:

I love walking by myself, you and your thoughts, it clears your mind. If I have a lot on my mind, I will just put my jacket on, and go for a long walk. Every time I come home, I am so chilled, my mind is empty. It makes you feel good (14.11.2015)

Managed realignment schemes were also perceived as intentional human interventions, which raised concerns, for example, one participant felt that it would be better to "… leave it alone, there is nothing wrong with [the potential sites for managed realignment] (24.10.2015)". One participant noted that the "instinct is to think that where it is good for nature and wildlife, it is basically stuff that has been left on its own for a while, and then [where there are] people, there is always going to be a conflict" and that it was "important to have places . . . where we can't actually go (14.11.2015)".

One of the groups that was aware of the farmland and flood risk also foresaw it to be difficult for the local landowners to accept managed realignment, saying: "I cannot see the farmers giving up their ground, to be quite truthful"; and noted the potential need for financial compensation: "I suppose there are ways of easing the pain for these things, like government subsidies (24.10.2015)". One of the groups who was concerned about coastal flooding discussed the responsibilities of the landowners to use their land with the effect on the broader community in mind, stating:

[The landowners] need to realise, although they own it, on a piece of paper that says it is theirs, if it is going to have an effect on everybody, the whole community, and potentially the wildlife, they need to kind of realise that their ownership is not there (24.10.2015)

3.4.2 Which institutions govern the Inner Forth shoreline from a citizen perspective? (RQ2)

During the group discussions in the citizen workshops, participants identified the following institutions as directly or indirectly involved in the governance of the Inner Forth shoreline areas: industries, government, schools and education, citizens, and social media and technology (Figure 4). Industries (21 times) and government (20 times) were listed most frequently as drivers of change on the Inner Forth shoreline. Fracking, driven by industries and potentially supported by the government, was discussed in all twenty groups, in terms of its impacts on the shoreline and how the industry was looking to

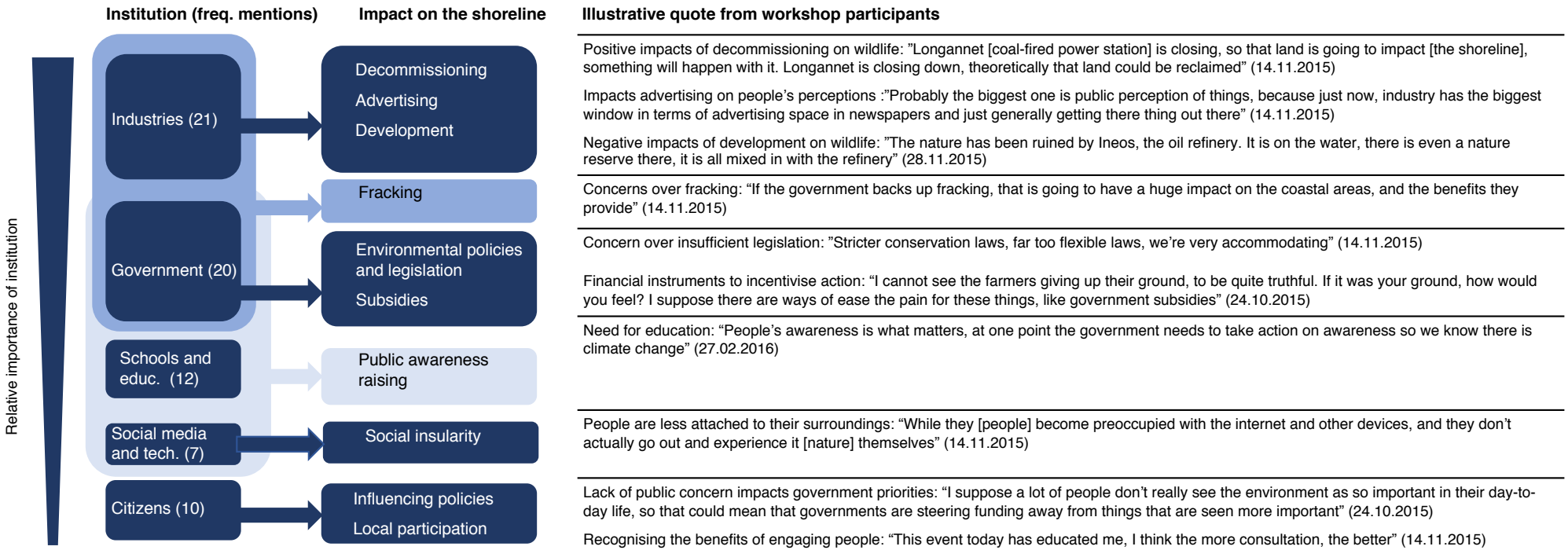

Figure 4. Institutions with an impact on the Inner Forth shoreline, as identified by the workshop participants. The frequency of mentions corresponds to the number of times each institution was listed as a driver of change on the mind maps in the twenty breakout groups. The shade of blue indicates how many institutions are involved in driving the impact (dark = 1, medium = 2, light = 3). The relative importance of each institution is indicated by the height of each institution, and the thickness of the line on the left

increase local support, by offering financial compensation and organising events (Figure 4). Illustrative quotes of citizens' knowledge and views regarding shoreline governance are included in Figure 4.

Social media, education and government were all seen to play a role in raising public awareness of the shoreline, which was highlighted as an important way of "increasing environmental awareness and attitudes . . . [and] train up the next generation to follow on what's been done at the moment . . . because a lot of people don't have an idea why wetlands are wetlands (14.11.2015)". It was also noted how Inner Forth residents are increasingly interested in local planning and policy, particularly young people, because more information is available to them. One group stated how importance it was to

> *"Try to reconnect people with the natural. Because if there is nobody connected to it, then there is no way to care and put in the work, when the physical work needs done, who is going to sign up for it (28.11.2015)"*

3.4.3 How does stakeholder engagement support shoreline adaptation in the Inner Forth (RQ3)?

Our interviews suggest that stakeholders in the Inner Forth discuss and collaborate on coastal management on both local and regional levels. At a local level, stakeholders collaborate through the charity-led Inner Forth Landscape Initiative, whereas at the regional level, they collaborate through the government agency-led Forth Area Advisory Group, and the Forth Estuary Forum.

Although these institutions succeed in bringing stakeholders together, we identified three ways in which these institutions (on both local and regional levels) are limited in their capacity to support coastal adaptation: financial resources, types of stakeholders involved, and scope.

At the local level, financial resources are a limiting factor in stakeholder collaborations to support coastal adaptation. The Inner Forth Landscape Initiative works with short-term funding (2014-2018) from the Heritage Lottery. Furthermore, the scope of the landscape initiative is a limiting factor, as it works towards broader social and environmental goals, rather than the explicitly addressing coastal adaptation. Up to now, no organisation

focuses on coastal adaptation and only the RSPB has taken up the managed realignment as a central objective in their broader biodiversity habitat restoration aim.

At both local and regional levels, the types of stakeholders involved is a limiting factor: the farmers we interviewed said they were neither involved in collaborations or discussions on coastal adaptation, nor do they feel included in decision-making. Half of the farmers we interviewed expressed interest in being included in decision-making, and felt that "there should be, at least the local farmers and landowners, but [also] people who just stay in the country, should all be involved in deciding in what's going to happen (interview on 23.02.2016)". Some farmers, however, were reluctant to take part and did not trust local policy-makers, as expressed by the farmer interviewed on 01.03.2016: "they would listen to you and that is how far they would go. My husband [a farmer] has a pretty poor opinion on how bureaucracy works".

For citizens, many workshop participants stated that they currently feel overlooked and uninformed by local authorities with regards to coastal management and climate change adaptation plans. Many participants realized "it is hugely important to actually ask people in the area what they think of all of this (28.11.2015)", and that "when it comes to meetings like this, we are overlooked (14.11.2015)", and that "we could improve awareness by getting you guys to do this every week (10.10.2015)".

3.5 Discussion

3.5.1 Hold the line or give in to the sea?

Overall, citizens and locally active organisations who do not manage privately owned land were positive or open to managed realignment in the Inner Forth, whereas the farmers and the trust were mostly critical. Based on the interviews with landowners, farmers and locally active organisations and the workshops with citizens (3.4.1), we show how 'holding the line' and nature-based approaches to shoreline defences differ along three scales: individual, local community and broader society.

On an individual level, 'holding the line' represents benefits by maintaining the reclaimed land for farming. The farmland provides livelihoods for several farmers in the Inner Forth area, and it represents agricultural land, associated with cultural values and traditions and translated into a norm not to retreat from the sea. However, these individual benefits carry a societal cost in the form of flood risks and associated damages. In addition, current legislation mandates that landowners are responsible to protect land from flooding, which translates into the continuous upkeep and maintenance of existing sea walls for farmers.

On a community level, managed realignment has more to offer, because it potentially allows for the restoration of up to 387 ha of wetlands (MacDonald et al. 2017) that would potentially deliver many benefits regarding both a decrease in flood risk, and an increase in wildlife habitat (Myatt et al. 2003; Jones and Clark 2014; Roca and Villares 2012; Myatt-Bell et al. 2002; Ledoux et al. 2005). Therefore, managed realignment enables more outdoor activities in nature, which residents described to contribute to their wellbeing. Discussions with Inner Forth citizens, however, revealed that the support they expressed for managed realignment schemes was mainly based on their nature-regarding, or biocentric values (Davidson 2015; Morelli 2016; Weesie and van Andel 2008), rather than the cultural and regulating ecosystem services that these schemes would provide for society. For instance, people often rejected the idea to make the newly created wetlands accessible through paths but preferred if these were to remain off-limits. This finding contradicts the common belief that motivations for wildlife restoration schemes cannot be solely based on biocentric arguments (Clewell and Aronson 2006; Aronson et al. 2006), and the trend for restoration to be mainly motivated by expected recreational possibilities for people (Aradóttir et al. 2013).

On a broader societal level, the main argument for 'holding the line' is food security and the norm that giving in to the sea means defeat. MacDonald et al. (2017) calculate that if all potential sites in the Inner Forth were realigned and converted back to wetlands, the annual income lost from all agricultural land to be worth just £33,732 (excluding subsidies). The potential economic value of nature-based flood management in the Inner Forth, in terms of increasing carbon storage (£316 700 per year, MacDonald et al. 2017),

wetland bird populations (£111 247, Kenter 2014), and water purifying ecosystem services (£489 234, Kenter 2014), far outweigh the costs of these schemes for society.

3.5.3 Shifting governance with sea level rise

A transition to inclusive and adaptive governance in estuarine and coastal areas is important in order to adapt to climate change impacts, minimise the risks of severe flooding events and the resulting property damage and risk to human lives, and enhance biodiversity benefits. One of the main challenges is to change the incentive structure that typically accrued benefits from land use changes such as wetland conversion to individuals, while the costs are borne by society at large. The example from the Inner Forth underlines this dilemma. Furthermore, the private benefits of wetland conversion are often exaggerated by subsidies such as those that encourage the drainage of wetlands for agriculture or the large-scale replacement of coastal wetlands by infrastructure, such as urban and industrial development (MEA 2005).

Coastal adaptation to climate change is supported by institutions (e.g. the landscape partnership) that facilitate collaboration and discussion between local stakeholders in the Inner Forth. However, they are limited in their capacity to deal with coastal adaptation in terms of scope, finances and stakeholders involved. These deliberative institutions could address the existing norms that hinder more sustainable coastal adaptation efforts in the Inner Forth (Anguelovski and Carmin 2011). We propose three principles for stronger inclusion of important stakeholder groups that should be considered in such institutions in the Inner Forth.

i. The inclusion of farmers. As we show above in the sections noted, they own most of the land where managed realignment could take place (3.4.1), hold identities that contradict giving in to the sea (3.4.1), and are currently not included in coastal planning (3.4.3).

ii. The inclusion of citizens (Few et al. 2007; Anguelovski and Carmin 2011; Dodman and Mitlin 2011; Wamsler and Brink 2014) and particularly vulnerable groups (Lesnikowski et al. 2015), because many of them hold strong intrinsic and biocentric

values for wildlife conservation (3.4.1) and do currently not feel sufficiently included in planning and decision-making (3.4.3).

iii. The involvement of industries (Aylett et al. 2010; Abel et al. 2011) that citizens identified to play a role in the governance of the Inner Forth shoreline (3.4.2). Including industry actors would potentially reduce the friction between interests (Granderson 2014) as well as legitimising the process towards a sustainable coastal development.

3.5.4 Inner Forth future

The Inner Forth is a place where the complex challenges of adaptation to climate change, the governance of estuarine and coastal ecosystems and the socio-economic barriers to change surface and reveal the underlying contradictions of the current political economy. The government of Scotland is keen to plan for and adapt to climate change, while also pushing for mitigation of climate change. Yet, the main industrial activity in the Inner Forth is associated with one of Europe's largest oil refineries. In some way, the image of the oil refinery with its smokestacks amidst the restored wetlands is a symbol of the contradictory logic that continues to mark many societies. On the positive side for climate mitigation, the Longannet coal-fired power plant, the single largest contributor to Scotland's greenhouse gas emissions, was recently shut down (Macalister 2016). Although this was not a direct outcome of ambitions to transition towards a more sustainable Firth of Forth, it nevertheless represents an opportunity towards a more natural state of the coastline for biodiversity habitat, flood protection and reconnecting local communities with the Forth estuary. Our findings highlight that stronger and more inclusive institutions for local stakeholder collaboration and deliberation could support adaptation to climate change through the restoration of natural ecosystems in the Inner Forth.

3.5.5 Conclusion

Rising tides mean local stakeholders need to work together more closely on shorelines, like the Inner Forth in Scotland. In some low-lying areas, shorelines may need to be intentionally realigned landwards to reduce flood risk, however, existing governance

arrangements may not support such changes. This paper has shown how citizens would appreciate the socio-cultural and wildlife benefits provided by nature-based shoreline defences, but this would result in trade-offs in the livelihoods, agricultural heritage and perceptions of current landowners. Existing institutions for collaboration and deliberation, such as landscape partnerships and advisory groups, need to be strengthened in terms of funding, stakeholder involvement and scope, to support knowledge sharing on the local impacts of sea level rise, and legitimisedecision-making. These improvements in governance would also help to overcome existing norms amongst farmers and locally active organisations, which currently work against nature-based coastal adaptation.

CHAPTER 4

Participatory integrated valuation of ecosystem services with citizens in the Inner Forth, Scotland.

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4.1 Introduction

Ecosystem valuation is an umbrella term for a diverse range of quantitative and qualitative approaches that examine the importance, need, demand, perception, preference or plurality of ecosystem services through cultural, ecological, social and economic dimensions (Dendoncker et al. 2013; Chan et al. 2012; Iniesta-Arandia et al. 2014; Kelemen et al. 2014). Ecosystem valuation underpins many of the practical applications of ecosystem services concept, such as Payment for Ecosystem Services schemes (Sattler and Matzdorf 2013), natural capital accounts (Natural Capital Coalition 2016), education (Wiborn 2013), design of policy instruments (e.g. REDD+, McDermott et al. 2013) and spatial planning (Scottish Borders Council 2016; Itkonen et al. 2015). Despite the wide range of uses and numerous valuation efforts, particularly from a monetary perspective

(Kushner et al. 2012), so far there is little evidence of valuation impact on policy and decision-making (Goldman et al. 2008; Laurans et al. 2013).

Many in both scientific (Silvertown 2015) and stakeholder communities (Glaves and O'Connor 2010) have criticised the narrow world view underlying the principles of monetary valuation, which currently dominate attempts to inform environmental policy and decision-making that impact or depend on the natural environment (Kelemen et al. 2016). Narrow world views in valuations can hinder or prevent a participant from articulating their values, excluding their views from the valuation findings. If a considerable portion of participants are excluded, this may limit the credibility and legitimacy of decisions based on the findings a valuation. In monetary valuation, participant's ability to articulate their values may be hindered if they are unwilling or unable to pay or receive money with regard to the policy question. However, also non-monetary valuations may exclude participants from articulating their values if they are based on narrow views of value.

We will address recent calls for integrated valuation of ecosystem services to incorporate biocentric, social and economic world views (Gómez-Baggethun and Martín-López 2014; Pascual et al. 2017). Recently, valuation approaches that integrate multiple world views have been developed conceptually (Diaz et al. 2015) and in practice (Hattam et al. 2015; Kenter 2016a). We add to the recent developments in integrated valuation by examining how narrow views of value can be overcome in both monetary and non-monetary valuations. Our exploration on how valuations can exclude participants focuses on five perspectives: space, use, ethical position, expression and process.

- Spatial metrics have been identified as a useful way of operationalising the ecosystem services concept in planning (de Groot et al. 2010) to set priorities (Gómez-Baggethun and Barton 2013), however, they may not be appropriate for expressing spatially fuzzy or implicit values (Brown 2004), particularly intangible cultural benefits (Brown and Raymond 2007) As a result, decisions based on spatial metrics may not

reflect deeper held social values that are not associated with specific places or spaces (Klain and Chan 2012).

- Use of an ecosystem service often provides a relevant measure of value, emphasising active or direct users (Burkhard et al. 2012). Decisions or priorities based on use values may however be perceived as unfair, if they undervalue areas with high non-use value, for example, inaccessible breeding sites of golden eagle.

- Ethical position taken in the valuation exercise may also not reflect the participant's world view, for example by focusing on anthropocentric benefit (Villamagna et al. 2014). In another example, the valuation methods require participants to trade off attributes that lead to outcomes that are perceived to be inequitable (Holland 2002).

- Expression is often an important part of articulating values for participants. Quantitative expressions allow comparisons, whereas qualitative expressions are more appropriate for expressing intangible values related to identity, sensory experiences or memories (Klain and Chan 2012; Satterfield et al. 2013).

- Process of valuation may also exclude participants from expressing their values. If the topic of the valuation is not familiar to the participant, participants often prefer more time to consider and discuss the topic (Spash 2007; Wilson and Howarth 2002) to help in forming better informed and confident views (Kenter 2016a).

In this study, we operationalise the five barriers to participant inclusion by designing a valuation process, which consists of a set of tasks that emphasise the different orientations of value. The valuation process is tested in a local-scale case of habitat restoration in the

Inner Forth, Scotland. The Inner Forth is the upper section of the Firth of Forth in the urbanising central belt of Scotland. The estuary has a rich industrial past, during which most intertidal marsh and mud areas (3000 ha) were reclaimed for farming and ports (Hansom et al. 2001). By 2080, UKCP09 relative sea level is projected to rise by 54 cm in the Firth of Forth with respect to 1990 levels under the high-end estimates of the high emissions scenario (Lowe et al. 2009), which would be in line with recent observations of local sea level rise (Rennie and Hansom 2011). Research and national policies are concerned about the sole reliance on conventional flood defences (Luisetti et al. 2011) and national policies are increasingly exploring natural flood management strategies across Scotland, including the Inner Forth (Edinburgh Council 2016). Natural flood management measures could be carried out on twelve parcels of reclaimed farmland and wasteland, restoring tidal marshes and mudflats (Figure 1). So far, conversion of farmland back to salt marsh has been viewed as a binary conflict between conservationists who want more wetland, and the farmers who would suffer losses in their agricultural production. Assessments of the public benefit from citizens' perspective have yet to be included in shoreline planning in the Inner Forth.

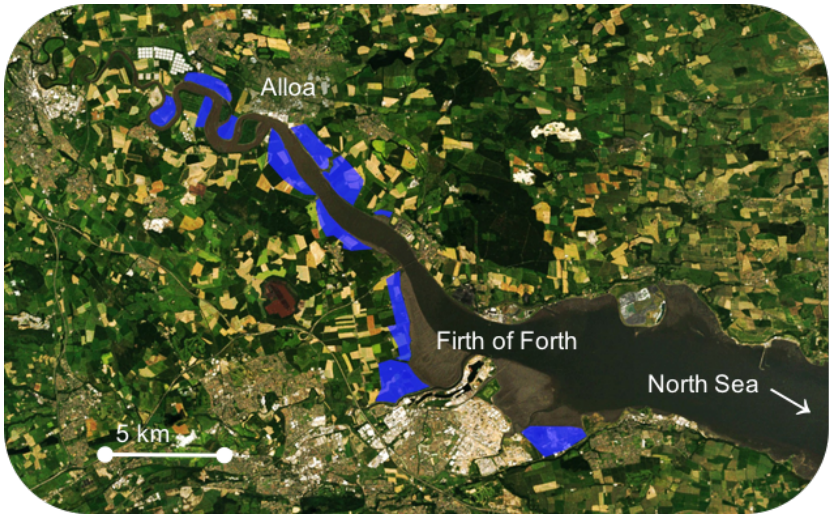


Figure 1. The integrated participatory valuation is carried out with citizens who live on the shores of the Inner Forth, which is the inner section of the Firth of Forth estuary. The blue areas highlight where tidal marshes could be restored or degraded areas could be enhanced.

A short survey-based valuation would not do justice to clarifying citizens' stake in this conflict, because the people residing in the Inner Forth are likely to have world views of different orientations, differ in their ability to take part, and have varying levels of awareness of the local area and related issues. These considerations are not only important for designing an appropriate process, but also for including appropriate questions in terms of space, use, ethical position and process.

Here we ask how different framings and processes differ in the outcomes they produce in ecosystem valuation. The valuation framings and process are coupled with the local context of the Inner Forth to examine how this landscape and potential shoreline realignment are viewed from a citizen perspective.

4.2 Methods

To measure how the values people articulate for the Inner Forth are affected by the framing of the valuation question, and by the deliberative process, we organised a series of five workshops with 109 citizens in the town hall of Alloa, one of the major towns on the shores of the Inner Forth estuary, in October 2015 – February 2016. The valuation process in the workshops was designed based on insights from scoping interviews with seven local stakeholders and 57 citizens, as described next.

4.2.1 Scoping

We carried out scoping in two stages. Firstly, we held four meetings with seven local stakeholders from government agencies and not-for-profit organisations to discuss shoreline management and policy in the Inner Forth. The purpose of these meetings was to feed the stakeholders' local and institutional knowledge into the diagnosis of valuation needs, in order to determine the geographic area and coastal management actions to be explored in the research. In the second scoping stage, we shortly interviewed 57 citizens to understand their knowledge and perceptions of environmental governance and shoreline areas in the Inner Forth. Based on the findings of the citizen interviews, as summarised in the three points below, we decided to broaden the valuation scope to cover

citizens' values for the wider landscape, even though the policy-focus is on the changes on the Inner Forth shoreline:

- The first reason for broadening the valuation scope was to make sure the Inner Forth citizens would be interested to take part in the research. Initial semi-structured interviews revealed memories of playing on the mudflats and wildlife explorations in people's childhoods in the past decades. However, the land reclaims for industrialisation and farming had played a part in disconnecting the communities from the shoreline. As one of the participants describes:

  Land reclaims have physically removed the village from the sea. [They] must have impacted the relationship between the village and foreshore. The more distance, the more you lose contact. Physically, mentally and emotionally (scoping interview participant, Alloa, 21.8.2015).

  This raised a doubt that the participants may not be willing or feel knowledgeable enough to contribute to a long workshop if the scope was limited to the shoreline that many had never even visited.

- Secondly, we broadened the scope to allow time for deliberation on priorities for the whole landscape before focusing on the shoreline. The short interviews with citizens suggested that they did not differentiate between ecosystem services to a great extent in terms of their importance (Figure A2-A3 in Appendix A). Although lack of clear priorities is not limitation per se, it may have been partly due to the limited time for discovering one's preferences.

- Thirdly, broadening the scope allowed us to examine how citizens valued the shoreline relative to other landscape elements. As the above quote suggests, the recreational and cultural connections to the shoreline have declined in the past decades, but it is not clear how the shoreline relationship is, or is desired to be, different from the rest of the landscape.

4.2.2 How values were elicited and analysed

The valuation process consists of three main steps that have different strategic foci: Shoreline Choices, followed by Landscape Deliberation and Shoreline Deliberation. The Shoreline Choices is repeated before and after the other valuation tasks to measure how participants' shoreline preferences change during the workshop. During Shoreline Deliberation, participants are asked to value potential shoreline changes from an ecosystem services perspective. The Landscape Deliberation was included for the three reasons outlined in 4.2.1.

Shoreline Choices (Steps 2 and 5)

To track how willingness to donate towards shoreline changes is shaped by the valuation process, Shoreline Choices (Steps 2 and 5 in Table 1) is repeated before and after Shoreline and Landscape Deliberation. Shoreline Choices is a choice experiment to elicit participants' willingness to donate towards shoreline changes. In this stated preference monetary valuation technique, participants are presented with a choice card, which contains three hypothetical shoreline options, and they are asked to choose which option they prefer. Each option is characterised with three shoreline attributes and a hypothetical donation (Hanley et al. 1998). The three different shoreline attributes are managed realignment, conservation actions and recreational paths. The choice experiment attributes are described in further detail in Table C1 in Appendix C. The changes in the shoreline attributes occur at different levels in terms of both magnitude and distance (detailed account in Table 2 in 5.5.3), however, in this chapter we only focus on changes in magnitude. In other words, we will look at how much participants are willing to donate for having, for example, recreational paths on all tidal land parcels where it is possible to create more paths (high magnitude of change) compared to having more paths on only on a small number of land parcels (low magnitude of change). Each choice card includes a status quo option, which does not involve a hypothetical donation. An efficient statistical design with four versions and six cards for the choice experiment was generated using NGene (version 1.1.1).

Participants are asked to weigh up the benefits, costs and their ability to donate when making a choice between the shoreline options, and to not choose options that involve donations that are not realistic. All participants were given the same information about the task and policy background before the first round. Participants complete a set of six choice tasks, so that changes in marginal value for each attribute can be inferred from the trade-offs participants make between the shoreline attributes and the hypothetical donation, derived through choice modelling (Bouma and van Beukering 2015). A detailed description of the choice experiment design is in 5.5.3 and Box C2 in Appendix C.

Landscape Deliberation (Step 3)

To elicit landscape values from an anthropocentric orientation, participants were asked to place stickers in locations that provide green space (Step 3.1 Table 1). Facilitators defined green space as any land or water that has vegetation on it, such as gardens, parks or paths. To elicit landscape values from a biocentric orientation, participants were asked to place stickers in locations that provide space for nature (Step 3.2 in Table 1), defined as any area where species can feed, rest, breed or grow. These species could be anything from mammals, insects, birds, fish, wildflowers or trees.

To elicit use values of the landscape, participants were asked to place blue stickers in locations that were visited of viewed and labelled according to their use on a basis of daily (d), weekly (w), monthly (m), couple of times a year (+y) or less than once a year (-y). To elicit non-use values of the landscape, participants were asked to use yellow stickers for locations that were not visited or viewed, and label according to the level of appreciation on a scale from 1 (a little bit) to 5 (a lot). Use and non-use values were mapped for both green space and spaces for nature (Steps 3.1 and 3.2 in Table 1). Participants used a simple map with light background and few place names to ensure there was enough space for participants to write on the map.

		Shoreline Choices Individual-based	**Landscape Deliberation** Group-based	**Shoreline Deliberation** Group-based
		Steps 2 and 5	*Step 3*	*Step 4*
Use	Yes		*3.1 3.2* Blue stickers indicate places that are visited or viewed	*4.1 4.2* Purple stickers for activity-based interactions with natural settings
	No		*3.1 3.2* Yellow stickers indicate places that are appreciated (not visited)	*4.1 4.2* Beige stickers for intellectual interactions with natural settings
	Analysis		*A frequency-based index is calculated according to reported visits (blue stickers) and Likert-scale scoring (yellow stickers)*	*Total number of stickers given to physical and experiential practices in each of the 20 groups; average and standard error of the mean are calculated for each group to compare their relative importance*
Space	Explicit		*3.1 3.2* Locations of natural settings recorded on a map	*4.1* Voting for priority sites for shoreline ecosystem services and biodiversity
	Implicit		*3.3* Natural settings and practices associated with the area are recorded on a mind map	*4.2* Voting for priority shoreline ecosystem services and biodiversity without specifying the site
	Analysis		*All features mentioned are categorised into either spatially explicit and implicit; spatially explicit features are then further categorised into six types, to identify which categories were mentioned in each exercise*	*Total number of sticker votes given to different ecosystem services and biodiversity are counted, to compare how their relative importance differs between the exercises*
Expression	Quantitative		*3.1 3.2* Frequency of visits to natural settings and scoring to indicate levels of appreciation	*4.1 4.2* Sticker voting for relative priority of different ecosystem services and biodiversity
	Qualitative		*3.1 3.2 3.3* Motivations and stories underlying settings and practices mentioned	*4.1 4.2* Discussion on motivations for votes
	Analysis		*A table is compiled to compare the quantitative and qualitative values given to the ten most important landscape features:* *To quantitative value is based on the number of times each landscape feature is discussed, mapped and listed* *The qualitative value is described by identifying all mentions from the interview transcripts, identifying three types of perceptions and four types of social value, which are then assigned to each landscape feature*	*A map is constructed to compare the quantitative and qualitative values of the shoreline land parcels:* *The quantitative value is based on the proportion of votes given to each parcel* *The qualitative value of the 12 shoreline parcels is described by identifying all relevant mentions from the interview transcripts, identifying four key themes (use, views, appreciation and history) that are assigned to each parcel, and by including illustrative quotes below the map*

(Continued)

(Continued)

		Shoreline Choices Individual-based	**Landscape Deliberation** Group-based	**Shoreline Deliberation** Group-based
		Steps 2 and 5	*Step 3*	*Step 4*
Ethical position	Anthropos		*3.1* Mapping and discussing green space	*4.1* *4.2* Votes for shoreline ecosystem services
	Bios		*3.2* Mapping and discussing space for nature	*4.1* *4.2* Votes for shoreline biodiversity
	Analysis		*A weighted frequency index is calculated based on frequency of mentions, to compare relative importance of the six categories between the positions*	*Total number of sticker votes given to different ecosystem services and biodiversity are counted, to compare how their relative importance differs between the positions*
Process	Quick	*2* Choice task at the start	*3.3* After the mind map exercise, examples of non-material ecosystem service benefits given	
	Deliberated	*5* Task is repeated to track changes in preference	*3.3* After examples, participants can add more to the mind map	
	Analysis	*Mean willingness to donate is estimated using a choice model and compared between steps 2 and 5.*	*All features mentioned are categorised into either spatially explicit and implicit; spatially explicit features are then further categorised into six types, to compare which of them were mentioned before and after the reflective intervention*	

Table 1. Overview of how different orientations of the value framings were measured and analysed for the three main parts of the valuation process. The integrated valuation was carried out in workshops with citizens living on the shores of the Inner Forth. The analysis for each step (2-5) is described in italics.

To elicit non-spatial values for the landscape, facilitators instructed the participants to construct a mind map of natural features that define the area and make it the place it is (Step 3.3 in Table 1). Natural features were defined as living things; landscapes, including coastal environments; special places; and scenery and places and moments when they see beauty and enjoy their surroundings. To allow time for reflection on less tangible features, for example, senses of belonging or sensory experiences, the facilitator gave more examples of non-material ecosystem service benefits (Church et al. 2011), once the participants felt that the mind map was complete. Then, participants were asked whether

they wanted to add features to the mind map, which the facilitators wrote down with a different coloured pen.

Shoreline Deliberation (Step 4)

Facilitators gave the participants a map of potential wetland restoration sites and a list of shoreline ecosystem services and biodiversity that would be affected by the restoration. Participants were given the opportunity to amend the list if they felt something was missing. To elicit quantitative and spatially explicit values for the shoreline, participant was asked to allocate ten stickers towards changes that were seen to be most important (Step 4.1 in Table 1). Colour of the sticker was chosen based on the kinds of changes that were seen as priority, so that relative importance of biodiversity (biocentric attribute) and ecosystem services (anthropocentric attribute) could be assessed. Biodiversity-related changes were coded in brown; flood and erosion regulation in black; water filtration in grey; carbon storage in purple; access in yellow; physical practices (use values) in light blue and experiential interactions (non-use values) in orange. The stickers were placed over sites that were seen to be priority. To elicit spatially implicit values, each participant was asked to vote for priority changes with three stickers according to the list of ecosystem services provided in the earlier exercise (Step 4.2 in Table 1).

4.2.3 Citizen engagement before workshop

We recruited participants by directly approaching individuals in the busy walking areas in the town of Alloa. The aim of this recruitment strategy was to achieve a cross-section of residents living in the Clackmannanshire area, with a geographic emphasis on areas near the shoreline. Participants were told the purpose of the research was to understand how residents think about their local landscape and future plans to inform local planning decisions. Participants were offered a £40 participation fee to be paid at the end of the workshop. Individuals were invited to bring a family member or a friend to encourage attendance. Bringing children was encouraged, and extra support was offered to individuals with health issues or child care duties.

4.2.4 Workshop programme

The workshops lasted five hours, beginning with an introduction, followed by seven exercises as part of the valuation process, and a follow-up questionnaire (Table 2). The workshop introduction, Shoreline Choices and follow-up questionnaire were facilitated by the lead researcher in plenary and tasks were completed individually. The Landscape and Shoreline Deliberation were group discussion -based exercises that were led by a trained team of facilitators in groups of three to seven participants. During Landscape and Shoreline Deliberation, facilitators encouraged discussion on motivations and storytelling so that narrative expressions could be captured. For larger groups, facilitators were supported by a scribe to help write down place names. The discussions were audio recorded for all groups.

Each part of the valuation process, which is composed of Steps 2-5 in Table 2, addresses a different combination of the five orientations of value framings (space, use, ethical position, expression and process), as indicated by the colour-coded ticks in Table 2.

Step	*Topic*						*Time*
		Perspectives					
1	Welcome and background	**Use:** Use Appreciation	**Space:** Explicit Implicit	**Expression:** Quantitative Qualitative	**Ethic.:** Anthropos Bios	**Process:** Before After	30 min
2	**Shoreline Choices**					✓	10 min
3.1	**Landscape Deliberation**	✓✓	✓	✓✓	✓		30 min
3.2		✓✓	✓	✓✓	✓		30 min
3.3			✓	✓✓		✓✓	30 min
4.1	**Shoreline Deliberation**		✓	✓✓	✓✓		15 min
4.2			✓	✓	✓✓		15 min
5	**Shoreline Choices**					✓	10 min
6	Follow—up questionnaire						5 min

Table 2. The Inner Forth workshop programme consists of three main valuation tasks (Steps 2-5). The colour-coded ticks indicate which orientation is addressed in each task. The overview does not include time for lunch and coffee breaks.

4.3 Results

Altogether 109 people participated in the workshops, from a cross section of residents living in Clackmannanshire (Figure 2). Participants had lived in the Inner Forth area for 28 years on average. About 35% of participants live in areas of South-East Alloa ('bottom end'), Clackmannan, Sauchie, Tillicoultry and Tullibody, which fall within the 20% most deprived areas in Scotland (Scottish Government 2016a). Majority of participants live in Alloa, within short walking distance from the areas where participants were recruited, and workshops were held, whereas five percent of participants live outside the Clackmannanshire area in Falkirk, Kincardine and Bridge of Allan. Amongst those participants who are employed, people with professional roles (e.g. engineering and education) were somewhat overrepresented and those with elementary roles, such as property maintenance, were underrepresented. The demographics are described in full

Figure 2. Altogether 109 citizens took part in the workshops organised in Alloa Town Hall on the shores of the Inner Forth. The three main valuation tasks in the workshop programme were Shoreline Choices (top left), Landscape Deliberation (right) and Shoreline Deliberation (bottom left).

detail in Appendix D. Altogether eight percent of people approached during recruitment took part in the workshops.

4.3.1 Space

To compare how landscape features mentioned during spatially explicit and implicit framings were different for Landscape Deliberation, majority of the 331 different landscape features were grouped into six categories:

- roads and paths (people described routes along which they walk, cycle or drive to enjoy or experience natural surroundings)
- history, art and architecture (features or places of cultural heritage that are immersed in the natural landscape)
- woods (diverse and frequently mentioned places of appreciation between the villages and towns)
- parks and nature reserves (places of outdoor recreation and/or natural heritage)
- other natural landscape elements (hills, islands and rivers)
- villages and towns (trees, flora and wildlife living in built-up areas).

These categorisations of landscape features were also used for use and ethical position during Landscape Deliberations. This broad categorisation was not applied to the remaining less implicit and intangible aspects of landscape value (for example, senses and feelings).

For Landscape Deliberation (Figure 3), the spatially explicit exercise resulted in a similar set of landscape features as the spatially implicit exercise. During both exercises, the participants discussed their experiences in both the natural and the man-made landscape: villages, paths, parks and old buildings. For the spatially implicit framing, the discussion also covered less tangible aspects of the landscape relating to seasonal change, senses and feelings, emotional and physical health and wellbeing:

If you are having a hard day, and you go for a wee walk along the river, you'll hear the running water sound, and that can in my opinion soothe or calm, mental health and wellbeing, for who people have done through a lot, it is great to be there, the smell of the spring time, the honey suckle, wild garlic, and the skies, we have got the most beautiful skies (workshop participant, 28.11. 2015).

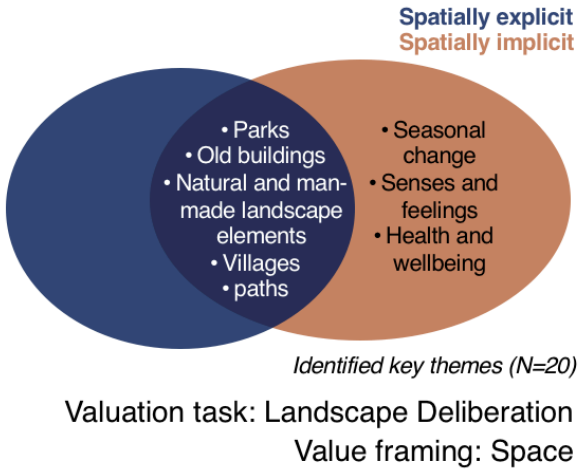


Figure 3. A comparison of how the workshop participants described the landscape during spatially explicit (blue) and implicit (brown) framings. The themes highlighted in the centre summarise key themes that were covered during both framings. Spatially explicit framings were used in Steps 3.1 and 3.2, and implicit framings during Step 3.3. The data was collected from the 20 groups in the five workshops in Alloa Town Hall.

For Shoreline Deliberation (Figure 4), biodiversity and experiential practices were more important in the spatially explicit exercise, whereas flood and erosion control were considerably more important in the spatially implicit exercise. Five groups added benefits relating to 'health, wellbeing and fitness' before voting, which was more important in the spatially implicit exercise. Overall, biodiversity and flood and erosion control were the most important benefits provided by the shoreline.

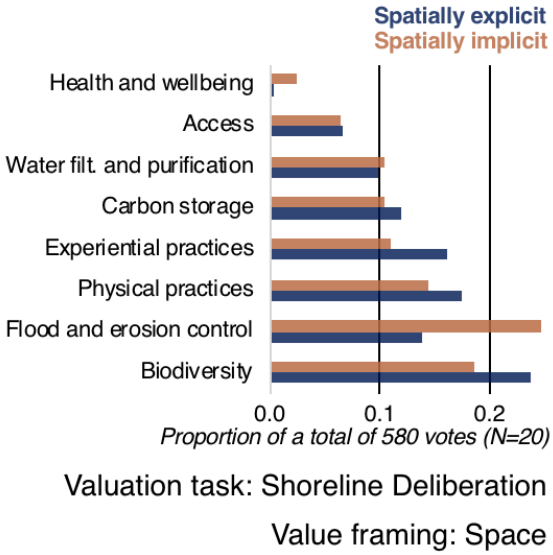


Figure 4. A comparison of how the workshop participants described the shoreline during spatially explicit (blue) and implicit (brown) framings. The relative importance of shoreline ecosystem services and biodiversity is indicated by the proportion of votes it received. Spatially explicit framing was used in Step 4.1, and implicit framing during Step 4.2. The data was collected from the 20 groups in the five workshops in Alloa Town Hall.

4.3.2 Use

For Landscape Deliberation (Figure 5), we recorded 11 visits, and 14 places or features of appreciation on average per participant. When the reported frequency of the visits is considered, we recorded an average of 210 annual visits per participant. Parks and nature reserves (34% higher) and roads and paths (3% units higher) gained higher use values compared to their non-use values. Woodlands gained a two-fold non-use value compared to the respective use value. Twelve different woodlands were mentioned for appreciation, whereas only nine woods were assigned a use value. Woodlands were appreciated for being "brilliant places to have in the world, because the provide us with a lot of oxygen and they should never be chopped down (workshop participant, 24.10.2015)". Recent changes in woodland areas were described to have impacted people's habits to walk in the woods:

There were some lovely woods that we used to walk with my kids and with the dogs because we liked the trees and the grasses. Now they are gone because of a commercial plantation. I have not actually walked there since (workshop participant, 14.11.2015).

Participants told how they had "lost countless species around here (10.10.2015)", and concerns were raised that "there is not going to be anywhere for the birds, the deer, [and] the fish to go (27.2.2016)". One group put forward that "it is time to start reintroducing some of them, [and] maybe get some of the woodland back (10.10.2015)".

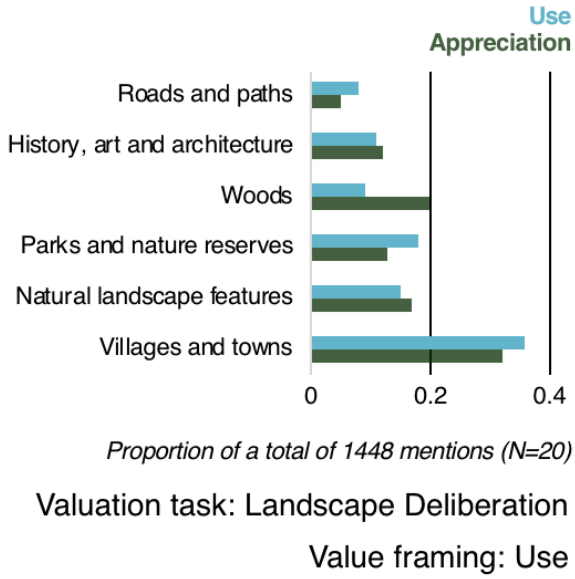


Figure 5. A comparison of how the workshop participants described the landscape during use (light blue) and non-use (dark green) framings. The relative importance of landscape features is indicated by the proportion of mentions it received. Use and non-use values were elicited using different coloured stickers in the mapping exercise during Steps 3.1 and 3.2. The data was collected from the 20 groups in the five workshops in Alloa Town Hall.

For Shoreline Deliberation (Figure 6), votes for experiential and physical practices were highly variable between the twelve shoreline parcels and the participant groups, and as a result, not significantly different at a 95% confidence level. Participants did not explicitly differentiate between experiential and physical practices in the discussions during the exercise.

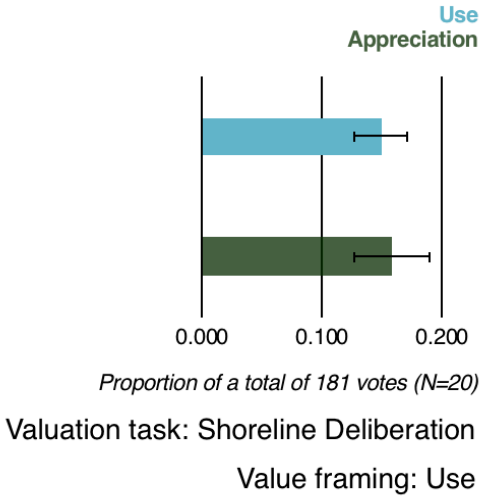


Figure 6. A comparison of the relative importance of use (light blue) and non-use (dark green) values for the shoreline. The use value is based on the number of votes for activity-based interactions with the shoreline, whereas non-use value is based on intellectual or mental interactions with the shoreline. The length of the bar indicates the average proportion of votes received across the 20 groups in the five workshops in Alloa Town Hall. The variation is estimated based on the standard error of the mean. Use and non-use values were elicited using different coloured stickers during Steps 4.1 and 4.2.

4.3.3 Ethical position

For Landscape Deliberation (Figure 7), participants assigned an almost four-fold anthropocentric value to roads and paths, and a 34% higher value for 'architecture, history and art', compared to the biocentric equivalents. Many of the mentioned roads and paths were back roads between the 'Hillfoots villages', shoreline paths, and disused railways for walking and cycling. The most often mentioned place for 'architecture, history and art' was the recently developed urban green space Helix, which is home to thirty-metre high sculptures known as the 'Kelpies' that symbolise the mythical water spirits of lowland Scotland, often appearing in the form of a horse.

The biocentric value for villages and their surroundings was 29% higher than their anthropocentric value. Out of the 25 towns and villages were mentioned, village area of Cambus by the Inner Forth shores was most important, valued for its shoreline features like the harbour, old weir and sand banks, but also the historical dovecot and whisky distillery.

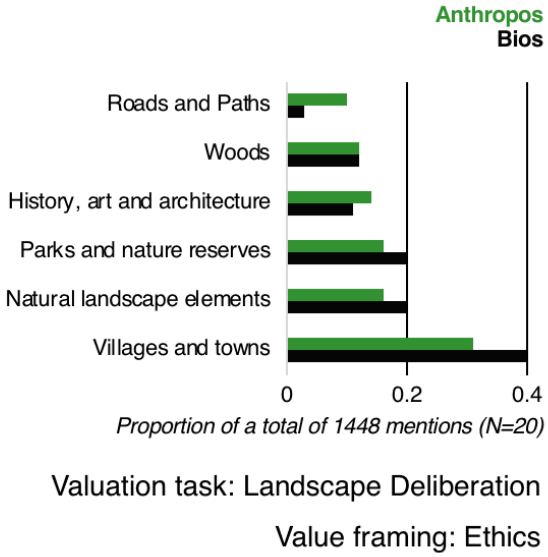


Figure 7. A comparison of the relative importance of different landscape features during anthropocentric (green) and biocentric (black) framings. The relative importance of landscape features is indicated by the proportion of mentions it received. Anthropocentric values were elicited during Step 3.1, whereas biocentric values were elicited during Step 3.2. The data was collected from the 20 groups in the five workshops in Alloa Town Hall.

For Shoreline Deliberation (Figure 8), anthropocentric features gained considerably more votes than biocentric features. This difference as more considerable during the spatially implicit (3.9 times more often) than the spatially explicit (2.7 times more often) exercise.

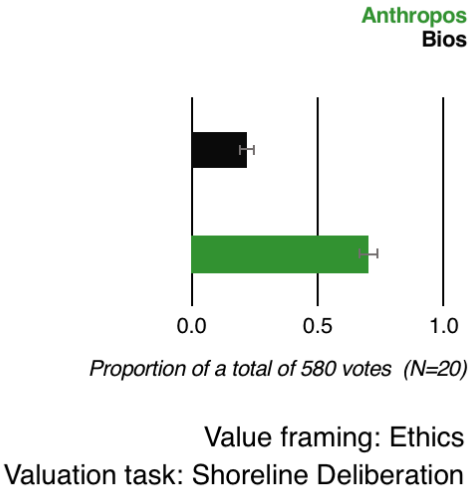


Figure 8. A comparison of the relative importance of anthropocentric (green) and biocentric (black) values for the shoreline. The anthropocentric value is based on the number of votes for ecosystem services provided the shoreline, whereas biocentric value is based on the votes for biodiversity on the shoreline. The length of the bar indicates the average proportion of votes received across the 20 groups in the five workshops in Alloa Town Hall. The variation is estimated based on the standard error of the mean. The anthropocentric and biocentric values were elicited using different coloured stickers during Steps 4.1 and 4.2.

4.4.4 Expression

For Landscape Deliberation (Table 3), all of the ten most often listed landscape features were spatially explicit, apart from 'animals and insects', which includes all mentions and stories of animal and insect life in the area that were not in relation to any specific place. The most often mentioned feature is 'Gartmorn Dam', an easily accessible and scenic country park that is a popular area for recreational walks and birdwatching, and rich in industrial history. The list also includes a village near the shoreline (Cambus), local woodland (Devilla), a historic and picturesque town by the river (Culross), the urban park with prominent public art (Helix), local hills (Ochil Hills), Alloa Town and its surroundings, local ponds, and a range of animals and insects.

Participants described three types of perceptions relating to the landscape features in Table 3: aesthetic qualities of different places, observations of seasonal change, and

remarks of historical change. The discussions also revealed four types of social values associated with the landscape features in Table 3. Participants shared experiences and memories regarding five of the listed features; expressed gratitude for having these places in their area; they were valued for providing space for nature (preservation of nature); and for being places of importance for many people living in the area (shared values).

For Shoreline Deliberation (Figure 9), participants discussed the twelve tidal land parcels, and allocated altogether 254 votes (average 2.33 per person) towards the parcels. Four core themes were identified from discussions regarding the shoreline parcels: views

	Frequency		Perceptions			Social values			
Feature	Quant.	Qual.	Landscape aesthetics	Environmental history	Seasons of the year	Experiences and memories	Gratitude	Preservation of nature	Shared values
Garmorn Dam	297	108	✓	✓	✓	✓	✓	✓	
Cambus area	144	52	✓			✓			✓
Devilla Forest	131	24		✓				✓	✓
Culross	112	27	✓	✓					✓
The Helix Park	103	25		✓					
Ochil Hills	95	71	✓		✓		✓		
Alloa Town	60	20		✓		✓	✓		
Delph Pond	54	10			✓	✓			
Animals and insects	53	40		✓	✓	✓		✓	
Inglewood Pond	52	8	✓	✓	✓				

Table 3. A comparison of quantitatively and qualitatively expressed values for the ten most important landscape features in the Inner Forth. The ten most important features were selected on the basis of how often they were mentioned in maps and lists (quant.) and in discussions (qual.) during Steps 3.1-3.3 in the citizen workshops in the Inner Forth. The symbols, which indicate perceptions and social values local residents associated with landscape features, is based on qualitative analysis of the discussion during steps 3.1-3.3. The table is compiled based on maps, mind maps and audio transcripts collected in the 20 groups in the five workshops in Alloa Town Hall.

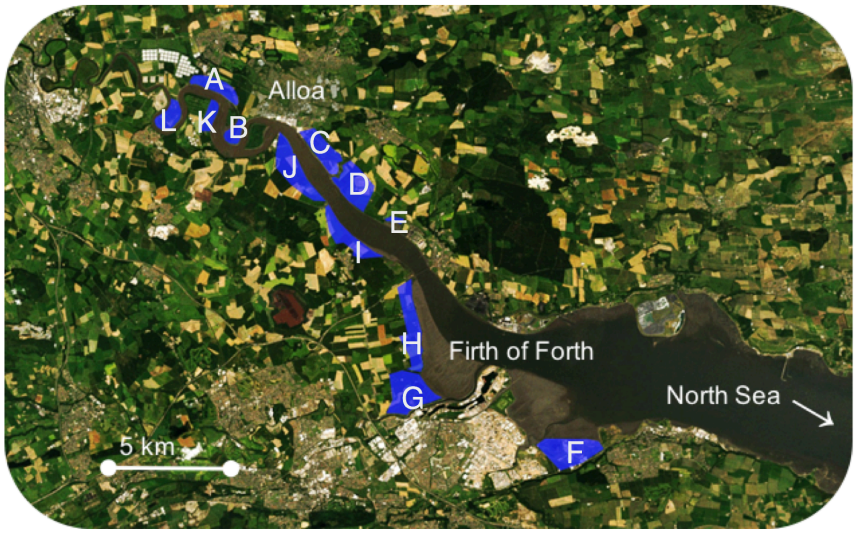
regarding land use and management, notions of environmental history, and expressions of use and appreciation.

The discussions regarding the shoreline predominantly regarded their recreational uses and aesthetic qualities. Three of the highest ranked shoreline parcels (which each received over ten percent of total votes each) were valued for different reasons:

- Cambus, a shoreline area by the village of Cambus with tidal pools and cycle paths, is a widely known and used nature-based recreational area, most valued for opportunities for enjoyment, outdoor activities and education, receiving 28% of the votes for experiential and 25% of the votes for physical practices.

- The Black Devon Wetlands, a newly established nature reserve, which many participants had recently become acquainted with, and also referred to as the 'Devon Marshes', was highly valued for the same socio-cultural benefits as Cambus (24% of physical and 17% of experiential practices), but also for biodiversity (24% of votes) and flood regulation (20% of votes).

- The Inch of Ferryton, which was known by few people to be a privately owned site, but not a familiar place to most participants, was highly valued for wildlife protection (23%) and water filtration benefits (20% of votes).



History
Views
Appreciation
Use

A	*0.13*	This water all over here [in Cambus] is exceptionally high.
B	*0.06*	(Rhind)
C	*0.19*	The RSPB have recently taken over the management of the Devon Marshes, so that could increase knowledge, variety, and also biodiversity, so it is all possible.
D	*0.16*	I cannot see the farmers giving up their ground, to be quite truthful.
E	*0.02*	From the point of view of recreation, I would have thought there was some scope for attracting sailing boats.
F	*0.05*	There's got to be something that balances things out, with Grangemouth in the area.
G	*0.04*	(Bothkennar Pools)
H	*0.09*	They have created a beautiful little wetland [in Skinflats].
I	*0.08*	I know that place [Airth] has got some flooding issues.
J	*0.10*	The residents in South Alloa can come together because there aren't that many of them, whereas we are fractured.
K	*0.05*	(Bandeath)
L	*0.05*	I would like to see Black Grange updated, it can be really mucky.

Figure 9. A comparison of quantitatively and qualitatively expressed values for the twelve shoreline parcels where wetland habitats could be restored or enhanced. The relative importance of the twelve shoreline parcels (A-L) is indicated in italics, based on the proportion of votes allocated by the workshop participants during Shoreline Deliberation in the Inner Forth. The parcels were associated with different combinations of the four main themes (their history, views regarding the sites, how they were appreciated and use) that were identified based on qualitative content analysis of the discussions during Steps 4.1 and 4.2. Illustrative quotes for each parcel are included on the right.

4.3.5 Process

For Landscape Deliberation (Figure 10), majority of the features participants listed were mentioned both before and after the reflective intervention; some were mentioned only after the intervention; and very few were only mentioned before the intervention. Features that were mentioned only before the reflective intervention included physical practices, like canoeing in the river. Features that were mentioned both before and after the reflective intervention include art, local places, natural landscape elements, flatness and sense of a rural place in the landscape, and its medieval heritage. After the intervention, participants also listed aspects relating to sensory experiences, maritime and industrial heritage, senses and feelings, seasonal change, health and wellbeing.

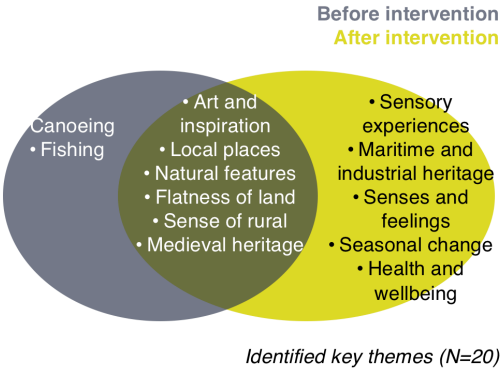


Figure 10. A comparison of how the workshop participants described the landscape before (grey) and after (yellow) the reflective interventions during the mind mapping exercise (Step 3.3). The themes highlighted in the middle summarise those key themes that were important before and after the intervention. The data was collected from the 20 groups in the five workshops in Alloa Town Hall.

For Shoreline Choices (Figure 11), mean willingness to donate is lower after the valuation for all three attributes: managed realignment (30% decrease), conservation actions (29% decrease) and recreational paths (93% decrease). The absolute decrease in willingness to donate is most considerable for conservation actions, from £5.20 to £1.52. For recreational paths, the mean donation drops from £1.78 to a slightly negative value (-

£0.13). For managed realignment, the value remains relatively highest despite the observed decrease (from £6.41 to £4.46). Results of the more detailed statistical analysis, including the statistical significance of the impacts of the deliberative process on values in a choice experiment is included in Table 3 and Table 4 in 5.6.2.

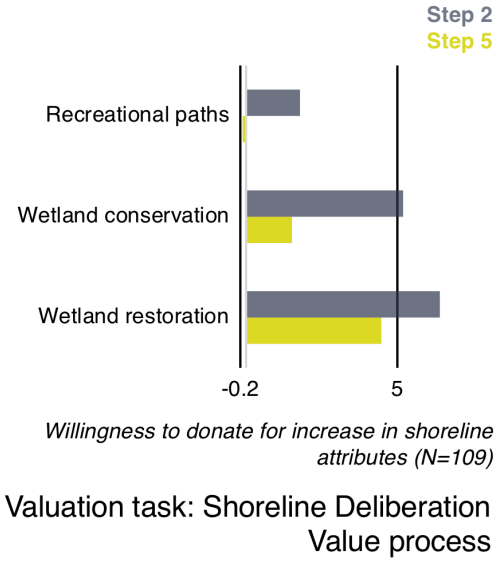


Figure 11. A comparison of shoreline values between Steps 2 (grey) and 5 (yellow), based on participants' hypothetical willingness to donate for increases in the three shoreline attributes (restoration, conservation and creation of paths). All 109 workshop participants completed the choice task individually in Steps 2 and 5. Willingness to donate for an increase in the shoreline attributes was estimated using a random parameter logit model.

4.4 Discussion

4.4.1 Discussion of results

We have taken a previously unexplored approach to integrated valuation of ecosystem services: first considering the ways in which the public may not be able to articulate their values for ecosystems, and then designing a suite of valuation exercises that attempt to overcome those barriers. We find that the different framings of use, space, ethical position and expression produce different valuation outcomes, apart from use and non-use values in the shoreline. We also find deliberative valuation processes to produce different outcomes for both the shoreline and the wider landscape. The importance of valuation

framings and processes in determining the valuation outcomes suggests that narrow framings and processes in participation can exclude participants' world views from the valuation outcomes.

Space

We learned that spatially explicit valuation exercises may not be appropriate for ecosystem services that are poorly understood by the participants. This is potentially the case for flood and erosion control in our study, which was identified to be a new or vaguely understood concept for many participants (described in detail in 5.6.1). Flood regulation was nevertheless the most important benefit in the spatially implicit ranking exercise. Conversely, when the participants were asked to value flood regulation on a map, its relative value dropped by 44%, implying that it was difficult to identify specific places where it was needed. This finding poses a challenge for the increasing calls to adopt spatially explicit valuation approaches (Scholte et al. 2015): it may not only be the familiarity with the geographic area that introduces a bias towards familiar features (Van Berkel and Verburg 2012), but also the familiarity with the ecosystem service itself.

An alternative explanation for the difference in flood regulation value is that the spatially explicit framings prompt participants to consider their values more strictly in a localised context, weighing up the benefits against their local priorities. According to this premise, the relative importance of flood regulation dropped because participants felt that flood regulation was not as high priority in their local area.

The spatially explicit exercise revealed interesting differences in the socio-cultural values held for different shoreline land parcels, providing insights to shoreline management (de Groot et al. 2010; Poe et al. 2014). For example, Cambus did not stand out as a place of high biodiversity value, even though it is home to a small wetland reserve, highlighting an interesting mismatch between the biophysical characteristics and people's perceptions. This suggests that more knowledge sharing could help in raising public awareness of the biodiversity benefits the site provides.

Use

This study brings attention to how the use and non-use framings provide different insights to ecosystem value, as is recognised in the Total Economic Value framework (Boardman 2006), but rarely considered in empirical studies (Klain and Chan 2012). The discrepancy was particularly prevalent for woodland values in the Inner Forth: difference between the use (9% of all mentions) and non-use values (20% of all mentions) of woodland (4.3.2), together with the stories of recent changes and of concern, imply a mismatch in the supply and demand for woodland ecosystem services. The stories (4.3.2) point to a downward trend of woodland species and recreational uses, indicating a decline in the supply of ecosystem services. The high non-use values suggest that, even though they were not directly used, socio-cultural benefits and wildlife preservation were in high demand amongst the Inner Forth residents. This discrepancy, together with observations of increased timber production, provide a tentative qualitative indication of an emerging trade-off between cultural and provisioning woodland benefits.

Ethical position

We find that nature in villages and towns, where wildlife lives in close contact with humans, were the highest regarded category of landscape features, especially from a biocentric point of view. These biocentric values were voiced in the workshops as the need to protect wildlife from the impacts of human activities. This finding is linked to one of the key dilemmas of urban ecology, arising from the tension between people's biocentric values for wildlife in the urbanising settlements, whilst at the same time, the frequent notions of people's dependence on and the celebration of local nature in the everyday lives. This conundrum can also be thought of as a trade-off between the use and the non-use values of cultural ecosystem services: the instrumental benefits versus the altruistic, bequest and existence values (Kenter et al. 2015).

This trade-off between biocentric non-use values and the impacts of different human activities on local wildlife is challenging to resolve as social-ecological systems continue to be rapidly built up (Haase et al. 2014), however, it can be mitigated for by changes in land use and management. For example, nature in the villages and towns of the Inner

Forth can be conserved and enhanced in many ways to mitigate this trade-off. Recreational parks, derelict land and riversides can be reframed and managed as corridors and stepping stones for wildlife (Breuste 2011). Street trees can be conserved and replanted, green roofs built, and allotments established in communal spaces to create more space for nature in urbanising settlements. If urbanisation is coupled with the creation of shared social spaces for deliberation and collaboration, it may foster active citizenship to "mobiliseresources and to act in the public policies in order to protect the rights and take care of common goods" (Moro 2012), including the ecology of urban areas, as demonstrated by Colding et al. (2013).

Expression

The discussion so far from the perspectives of space, use and ethical position has already illustrated how useful both quantitative and qualitative expressions are in providing insight in participatory valuations. Here we consolidate this argument using the Gartmorn Dam as an example, which we found to be the most important place for people in the Inner Forth. The Gartmorn Dam was given overwhelmingly high attention out of the 331 features and places mentioned in both the participatory GIS and the discussions (Table 3), obtaining over twice as many mentions than the second most frequently mentioned place. The quantitative pattern of demand for ecosystem services, which revealed the importance of Gartmorn Dam, is interesting from a public policy perspective, as it can help to guide the allocation of existing resources (Brown et al. 2014) for land use planning and management (Brown and Donovan 2014). It was, however, only the qualitative, often spatially implicit and sometimes also deliberated values that revealed the past and current processes that underpin the hot spots of socio-cultural value, such as Gartmorn Dam. This finding challenges the use of participatory GIS applications (e.g. Rantanen and Kahila 2009) as tools for socio-cultural valuation. We find that the deliberative discussions to unveil deeper held associations of value, similarly to Kenter et al. (2016a): the high popularity of Gartmorn Dam was based on the aesthetic experiences, knowledge about its' historical past, and feelings of gratitude.

Process

Whereas Pascual et al. (2017) view deliberation as an integrative tool for resolving conflicts over values in integrated valuation, we have utilised it to facilitate reflection, in order to elicit deeper-held values for the Inner Forth landscape, but also to illuminate the impacts of the valuation process on the values elicited. We found the reflective deliberative intervention to shape the outcomes the deliberative discussion: participants dwelled deeper into the underlying factors and processes of socio-cultural benefit, such as the sensory experiences, notions of heritage, senses and feelings, and the impacts on health and wellbeing.

Our findings from the Shoreline Choices also support the idea of the valuation process shaping the outcomes of participation: at the end of the workshop, participants were willing to donate less towards shoreline changes (Figure 11; detailed statistical analysis later in 5.6.2). As we discuss later in 5.7.1, it remains unclear why they are willing to donate less. Participants are potentially considering the task and the hypothetical donation more seriously, or they become pickier about the changes they would like to see on the shoreline. Kenter et al. (2016a) and Kenter (2016a) also found participants to consider changes in the attributes more carefully after deliberations, resulting in decreased WTP.

4.4.2 Discussion of methods

Participants were asked to consider how much they are willing to donate towards shoreline changes, which presents three types of barriers to articulating values: familiarity with the idea of, agreement with the idea of, and ability to donate money. Firstly, participants may not be *familiar* with the idea of donating money, which presents a barrier particularly in subsistence-based economies. Higuera et al. (2013) demonstrate how this barrier can be overcome by using time as a currency of donation instead of money. Secondly, participants may not *agree* with the idea of donating money. This was a potential source of concern for the 5% of the participants who were not satisfied or did not want to complete the choice tasks, which is explored in further detail in 5.6.2 and Table F1 in Appendix F. Thirdly, participants may not be *able* to donate due to financial or social constraints. We attempted to overcome this barrier by setting a low minimum monthly

donation (£2), but even so, participants with more financial income could choose from a wider range of options than those who could not donate higher amounts. We also framed the monetary attribute as a donation instead of an increase in tax, as this would have excluded participants who do not pay tax due to e.g. unemployment.

Carrying out the valuations in groups prevents us from assessing how many participants faced the barriers mentioned above, in the framing of the valuation. When valuations are done in an interview setting, this assessment is possible: for example, Klain and Chan (2012) found that nine out of 25 interviewees did not want to assign quantitative measures of importance because they did not want to imply that places of importance can be ranked, and for seven out of the thirty interviewees it did not make sense, or they did not want to assign their ecosystem service values to specific places. On the other hand, the spatial and quantitative tasks in this study were not only output-driven tasks, but also tools for conversation, which could have reduced resistance to spatial and quantitative framings.

The research design of the participatory valuation consisted of numerous steps to address the different framings and processes during the workshops. This type of approach is often not feasible, which makes our approach unpractical to implement if time and resources are limited. Our findings suggest that some of the framings could be aligned to reduce the number of activities for shorter valuation tasks. For example, spatially fuzzy or implicit features, like Ochil Hills and 'animals and insects', were mentioned relatively more often in discussions than in the participatory maps (Table 3), suggesting that spatially implicit and qualitative framings can be clustered together.

4.4.3 Implications of results and future research

Our findings provide clues to how different world views (ecological, socio-cultural and economic) can be integrated to participatory valuation studies in practice. In the following, we outline how capturing the ecological and socio-cultural world views provide particularly useful information to support policy developments that reflect citizens' goals, principles and values. The economic world views, on the other hand, are best captured by tangible metrics that highlight hot spots of social demand to support priority setting in practical landscape management.

Ecological world views, which emphasise the 'safeguarding resilience and ecological integrity' were found to be best captured by appreciation-based (i.e. non-use) and, not surprisingly, biocentric framings. The questions about the non-use values of the local landscape prompted relatively more mentions of woodlands, which were highly regarded for their ecological importance, implying high intrinsic values, which are associated with ecological world views. Our findings also highlight how the inclusion of biocentric framings in social valuations allows people to share their wildlife experiences and which species they care for; however, it does not necessarily reflect ecological conservation priorities. The biocentric framings did not emphasise places of most pristine nature, instead, they brought up places of everyday interaction between nature and people in villages and towns. Future work on eliciting ecological world views held by the public should be co-produced more closely with local policy-makers, to allow the findings to feed directly into deliberations on whether the existing policies reflect citizens' values.

Socio-cultural world views that focus attention on the 'well-being of present and future generations' (Boeraeve et al. 2015) are well captured through qualitative, anthropocentric and deliberated expressions. These expressions reflected benefits associated with health, well-being, and sensory experiences. The anthropocentric framings, when expressed spatially explicitly, pointed towards paths and historical heritage features (e.g. castles and ruins) that were important places for recreation. The qualitative framings, helped to understand the underlying socio-cultural context for quantitative patterns of value, as participants shared knowledge, expressed moral considerations, and why they used or appreciated different places. The deliberated framings aligned closely with the qualitative

framings: we found that the reflective deliberative intervention prompted notions of deeper held values relating to heritage, senses and well-being in the landscape. A workshop format, which allows for deliberations and discussion, is therefore a good platform for capturing socio-cultural values in decision-making. Similarly to the point made above on ecological world views, future work on eliciting socio-cultural world views should be knit more closely with policy, so that policy-makers can reflect directly on whether existing policies reflect socio-cultural needs, goals and principles.

The economic world views, underlining 'economic efficiency and long-term viability' (Boeraeve et al. 2015) were best reflected through use-based, spatially explicit and quantitative measures, as they better capture the benefits that individuals derive from different places in their day-to-day life. These tangible measures provided a better understanding of which parks, landscape elements, villages and paths were most used and appreciated, which can be used to allocate resources in planning. The use values highlight where resources need to be directed to support socio-cultural benefits, for example, the maintenance of parks and paths.

These observations take us to three key recommendations for future research in integrated valuation of ecosystem services:

1) To facilitate the inclusion of ecological world views, valuation exercises should include questions and tasks that enable participants to articulate non-use values (e.g. appreciation), but also allow to place special importance on biocentric viewpoints (e.g. space for nature).

2) To facilitate the inclusion of socio-cultural world views, valuation exercises should, in addition to the above-mentioned recommendations, allow qualitative expressions of principles and importance (e.g. story-telling), as well as deliberation on values (e.g. group discussions), and placing special importance on benefits to people (e.g. green spaces to enjoy).

3) To facilitate the inclusion of economic world views, valuation exercises should, in addition to the above-mentioned recommendations, enable the articulation of use-based (e.g. visits), spatially explicit (where) and quantitative expressions of value (scoring or WTP).

4.4.4 Conclusion

This integrated valuation of ecosystem services with citizens in the Inner Forth asks how different framings and processes of participation lead to different valuation outcomes. We find quantitative, use-based and spatially explicit values, which emphasise economic world views, to provide the pattern of demand for ecosystem services. Qualitative, deliberated and anthropocentric values, which best reflect socio-cultural world views, provide a better understanding of the social processes leading to the demand for ecosystem services. Finally, we find that the biocentric orientations of value (unsurprisingly), together with non-use values, to best reflect the ecological world views. Our findings challenge researchers to consider whether their standardised methods for valuation, such as participatory GIS, choice experiments or other ecosystem services tools, may be too narrow in their framing and process, to the extent that the intended participants who hold incompatible world views are excluded. Considering these aspects supports the field of ecosystem services to develop better processes for participatory integrated valuation.

CHAPTER 5

Deliberative framework for addressing awareness gaps in environmental valuation: Choice experiment with citizens in the Inner Forth, Scotland

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5.1 Introduction

Values we hold underpin the formal and informal decisions we make, including those affecting the environment (Schwartz 1992; Bardi and Schwartz 2003; Stern et al. 1999). Environmental valuation describes the values that individuals, groups or institutions hold for environmental features (such as water quality or biodiversity), with the aim of informing environmental decision-making, such as choosing between alternative land use options (Lienhoop et al. 2015). These decisions can be undermined, if they are informed by valuations in which the participants were not sufficiently informed (Fischhoff 2000). We address this issue of awareness gaps in environmental valuation using deliberative choice experiments.

This paper addresses awareness gaps through knowledge sharing from both local and expert perspectives. Knowledge held by experts, such as researchers, can help to understand how local areas are influenced by for example global changes (Anthony et al. 2009) or underlying ecosystem functions (Scarano 2006), or the extent to which an ecosystem is unique and irreplaceable (Le Saout et al. 2013). In contrast, local knowledge is often moral, qualitative and based on empirical observations, depicting the ecology and human uses of a specific area (Folke 2004). Studies so far on deliberative environmental valuation have not explicitly differentiated between local and expert knowledge.

Expert and local knowledge are underpinned by different world views (Shi et al. 2016; Milfont 2012; Ajzen et al. 2011), which are also exposed when knowledge is shared in deliberative interventions. This results in social learning (Webler et al. 1995), as individuals become more aware of different world views, helping participants situate the knowledge that others project in their point of view, but also by revealing any shared values amongst individuals and groups (Kenter 2016b).

Weaving in expert and local perspectives requires a shift away from the common fast-track formats, such as surveys or online questionnaires, which rely heavily on participants' existing awareness of knowledge and world views. Deliberative formats, such as workshops presented here, allow for both social learning through group-based discussion tasks (e.g. Crum et al. 2009) and individual learning through e.g. repeated rounds of a choice experiment, as participants learn to complete choice tasks (Carlsson et al. 2012).

In this Inner Forth case study, we develop and test a deliberative framework for addressing awareness gaps in environmental valuation. Few studies (Bullock and Kay 1997; Alvarez-Farizo et al. 2007) so far have emphasised the importance of addressing awareness gaps in their method, explicitly diagnosing awareness gaps and designing the deliberative interventions to address these gaps. We take participants' awareness as the starting point to direct the design of deliberative interventions and measure their impact on participants' WTP using a choice experiment. We incorporate expert knowledge in the valuation process under the ecosystem services and climate change frameworks. Local

knowledge and views regarding the Inner Forth are brought into the valuation through discussion to share information about the area and reveal local attitudes and practices. We show that addressing participants' awareness gaps considerably changes their preferences and willingness to donate towards shoreline management measures.

The primary aim of this study is to develop a deliberative framework to address citizens' awareness gaps from both expert and local perspectives during environmental valuation. We then apply this framework to measure how participants' WTP for natural flood management measures changes after deliberative interventions in a workshop. The second aim is to measure the impact of the valuation format (face-to-face interview or workshop) on the elicited values. We hypothesise that the deliberative interventions impact WTP, as participants learn socially and individually during the choice tasks and deliberative interventions. We also hypothesise that the choice models perform better, as clearer preferences emerge, and the preferences converge towards others in the group. The impact of the interventions and the format is measured in WTP, and the process of deliberation is documented and reported qualitatively.

We first review the literature on deliberative valuations so far (5.2), describe the Inner Forth shoreline (5.3) and the proposed deliberative framework for valuation (5.4), followed by our methods (5.5), the results (5.6) and the discussion (5.7).

5.2 Literature review of deliberative valuation

We find eight studies where the emphasis has been on testing the impacts of expert-driven deliberation on willingness to pay. Expert perspectives can be brought into the valuation through interventions that combine presentations, discussion to clarify and ask further questions, and time to deliberate on the information between sessions. The findings have been mixed: Álvarez-Farizo and Hanley (2006), Bergstrom et al. (1990) and Robinson et al. (2008) found preferences to change, whereas MacMillan et al. (2006), Dietz et al. (2009), and Christie and Rayment (2012) do not find significant changes in preference and WTP. Christie et al. (2006) and Robinson et al. (2008) find that information and opportunities to discuss and ask questions improve the overall performance of the models

estimated, and Shapansky et al. (2008) and Alvarez-Farizo and Hanley (2006) observe preference convergence within the group.

Local perspectives have been the focus of several deliberative environmental valuation studies (Álvarez-Farizo et al. 2007; Kenter et al. 2011; Völker and Lienhoop 2016; Kenter et al. 2016a; Webb et al. 2016), which find discussion-based interventions to increase awareness of local knowledge and world views through social learning (Reed et al. 2010). Kenter et al. (2016a) and Kenter (2016a) find WTP to change after deliberations on local knowledge, whereas Lienhoop and Völker (2016) do not observe statistically significant impacts on WTP. Kenter et al. (2011) find that many ecosystem services become priceless, as participants become unwilling to trade off attributes for cost. Kenter (2016a) finds WTP confidence intervals to increase, as participants undergo systemic learning and better understand others' world views.

We find eight deliberative environmental valuation studies that compare workshops and interviews as valuation formats (Falk-Andersson et al. 2015; Lienhoop and Macmillan 2007; Macmillan et al. 2002; Kenter et al. 2016a; Álvarez -Farizo and Hanley 2006; Christie et al. 2006; Lienhoop et al. 2005; Shapansky et al. 2008). Several studies show evidence that valuation format shapes preferences and WTP, for example, Kenter et al. (2016a) and Lienhoop and Macmillan (2007) find WTP to be higher in workshop formats as participants have more time to familiarise themselves with unfamiliar ecosystem ecosystems and services. However, Álvarez-Farizo and Hanley (2006) and Macmillan et al. (2002) find WTP to be lower in workshops because, for example in the latter study, participants take the payment aspect more seriously. Christie et al. (2006, n=53) and Shapansky et al. (2008, n=24) find that WTP does not differ between workshops and interviews, which could be explained by the poor model fit due to low sample size in the workshop choice experiments.

We also find two studies that share a mixture of expert and local knowledge. Urama and Hodge (2006) find that it increases WTP for local landscape management, whereas MacMillan et al. (2006) find it to impact WTP for unfamiliar but not familiar landscape

features. Changes in WTP for unfamiliar features suggest that awareness gaps impact participants' stated preference, and that addressing awareness gaps may mitigate the negative effects on values expressed in stated preference research.

5.3 Inner Forth, Scotland

The shoreline of the Inner Forth, located in the central belt of Scotland (Figure 1), mainly consists of reclaimed farmland, industrial brownfield, and remnant stretches of tidal marsh and mudflats. Industrial activities continue to cease, and new housing schemes are being developed in the low-lying lands by the shoreline. The Inner Forth is home to many neighbourhoods that are amongst the most socially deprived in terms of socio-economic factors, particularly health, crime, education and income (Scottish Government 2016a). The area has recently benefited from Heritage Lottery Funding to enhance the ecology and social use of green spaces and raise local awareness of its natural features (Inner Forth Landscape Initiative 2014). If sea levels continue to rise at rates above the central estimates of the high emissions scenario (Lowe et al. 2009), which has been the case in the recent decades (Rennie and Hansom 2011), relative sea levels could rise by 54 cm by 2080 compared to 1990 levels (Lowe et al. 2009).

Stakeholders are investigating the possibility of realigning the river edge landward, a technique known as managed realignment, which has been proposed as an economically and environmentally sustainable option for climate change adaptation in the UK (Turner et al. 2007; Luisetti et al. 2011). Managed realignment would lead to the restoration of tidal marshes and flats in the area (Wolters et al. 2005). Furthermore, many of the existing tidal areas are in poor ecological status, which could be alleviated by undertaking active conservation measures. Local ecologists estimate that restoration and enhancement activities could lead to considerable increases in numbers of breeding wildfowl and waders. Access along the riverbanks is currently limited in many places due to poor condition or lack of paths. The Inner Forth area falls under four local municipalities, which poses further challenges for co-ordinated estuarine governance (3.2). This study focuses on residents living near the town of Alloa, which is near four of the sites where tidal habitats could be restored or enhanced (Figure 1).

Figure 1. The Inner Forth is the inner section of the Firth of Forth estuary, which flows into the North Sea. The areas highlighted in blue (twelve parcels in total) indicate where coastal realignment or the enhancement of degraded tidal habitats could be carried out, based on several feasibility studies. A series of workshops was organised in Alloa, a town within walking and cycling distance from four out of the twelve tidal land parcels.

5.4 Deliberative framework

The deliberative valuation framework developed here consists of three steps: identifying and describing awareness gaps from expert and local perspectives, addressing the identified awareness gaps, and measuring impacts of addressing awareness gaps (Table 1). The valuation framework begins with a scoping phase followed by the valuation phase.

During the scoping phase, participants' awareness of knowledge and worldviews are tested in short interviews to identify and describe gaps that would make it difficult to respond to the valuation question. For example, participant may not be aware of an ecosystem service, or how other local people benefit from an area. The researcher can assess the awareness gaps qualitatively and/or quantitatively during the scoping phase.

The valuation phase consists of deliberative interventions and valuation tasks, e.g. choice experiments, which are repeated before and after deliberations in the workshop. During the valuation phase, the values with respect to the policy question are measured according

to the valuation method. The process of deliberation is recorded on audio recordings, notes and/or participatory drawings or maps.

The impacts of the valuation format are tested by also carrying out the tasks in a face-to-face interview. The workshops and interviews differ in terms of the time invested, travel effort, individual attention received, social dynamic and compensation. Workshop participants give up several hours of their day and travel to a local venue, whereas interview participants only spend 10-15 minutes, and do not have to travel. The workshop participants receive instructions in plenary with limited opportunity to ask for clarification and help, and they are required to fill in their own responses, whereas interview participants receive an individual explanation and help with recording their responses. In the workshops, participation occurs in the presence and preceded by interaction with others. Workshop participants also receive a participation fee to compensate for their efforts and time of the workshop participants, and to attract demographic groups who may not otherwise attend.

Both local and expert perspectives (C1 in Table 1) are considered with respect to the policy questions in the valuation task. Local perspectives are addressed through discussions with local community members to facilitate sharing of knowledge and views on the local area with respect to the policy question. Expert perspectives are addressed in the learning-based intervention, during which participants are exposed to expert knowledge and views on aspects of the policy question that were identified unfamiliar during the scoping phase.

Step		1. Identifying awareness gaps	2. Address awareness gaps	3. Measure impact
A. Research phase		Scoping	Valuation (e.g. choice experiment)	
B. Format		Short interview	Workshop	Workshop and face-to-face interview
C. Knowledge	*Expert*	Ecosystem services and climate change	Learning-based intervention	WTP for shoreline options before and after intervention
	Local	Local areas, uses and attitudes	Discussion-based intervention	WTP for shoreline options after intervention

Table 1. The deliberative framework for addressing awareness gaps in environmental valuation. The table highlights how each step of the framework was put in practice in the Inner Forth.

5.5 Methods

In the scoping phase of the study we aimed to identify awareness gaps in local knowledge regarding shoreline biodiversity, ecosystem services and climate change. We interviewed altogether 53 citizens for 5 minutes to 1 hour to gauge their awareness of the local area and the shoreline. Statement scoring and pebble distribution exercises and, if time allowed, open-ended interviews were carried out by four researchers over four consecutive days. The questionnaires are in Box A1 and A2, and the interview details are in Box A3 in Appendix A.

For the main study, we organised a series of five workshops for 109 participants in Alloa Town Hall on Saturdays between October 2015 and February 2016 and carried out face-to-face interviews with 98 people in Alloa between November 2015 and August 2016. These participants were different from the 53 participants in the scoping phase. The face-

to-face interview participants took part in a single-stage choice experiment, whereas the workshop participants took part in a three-stage choice experiment with two deliberative interventions. Before the first stage of the choice experiment in the workshops, participants were given the same set of information in plenary (Box B1). All adult workshop participants were paid £40 at the end of the event.

The recruitment process for both interviews and workshops is described in detail in 5.5.1, after which we explain how we addressed awareness gaps through deliberative interventions in section 5.5.2. The impact of the deliberative interventions is measured by performing a choice experiment at three stages in the workshop process (see Figure 2), and in section 5.5.3 we discuss choice experiment design. There are three supplementary documents in which the scoping (Appendix A), workshops (Appendix B) and the choice experiment (Appendix C) are explained in further detail.

5.5.1 Recruitment of participants

The majority of participants live within 1-5 km from the river Forth, primarily from Clackmannanshire. Focusing on residents from one area instead of the entire region limits the variability in preferences because respondents have a similar if not identical geographical reference point, making it easier to interpret changes in WTP due to deliberative interventions. Participants were directly approached on the busy pedestrian areas in Alloa (Figure 1) and invited to take part in an interview or workshop. Scoping phase interviews were completed in June-August 2015, the workshops were held in October 2015-February 2016, and face-to-face interviews were carried out in November 2015-April 2016. Individuals who were invited to the workshop were encouraged to bring a friend or family member if that would make them feel more comfortable to attend. All participants filled in a background questionnaire before taking part in the study (Figure B1 in Appendix B). More details about the workshop methodology are included in Appendix B.

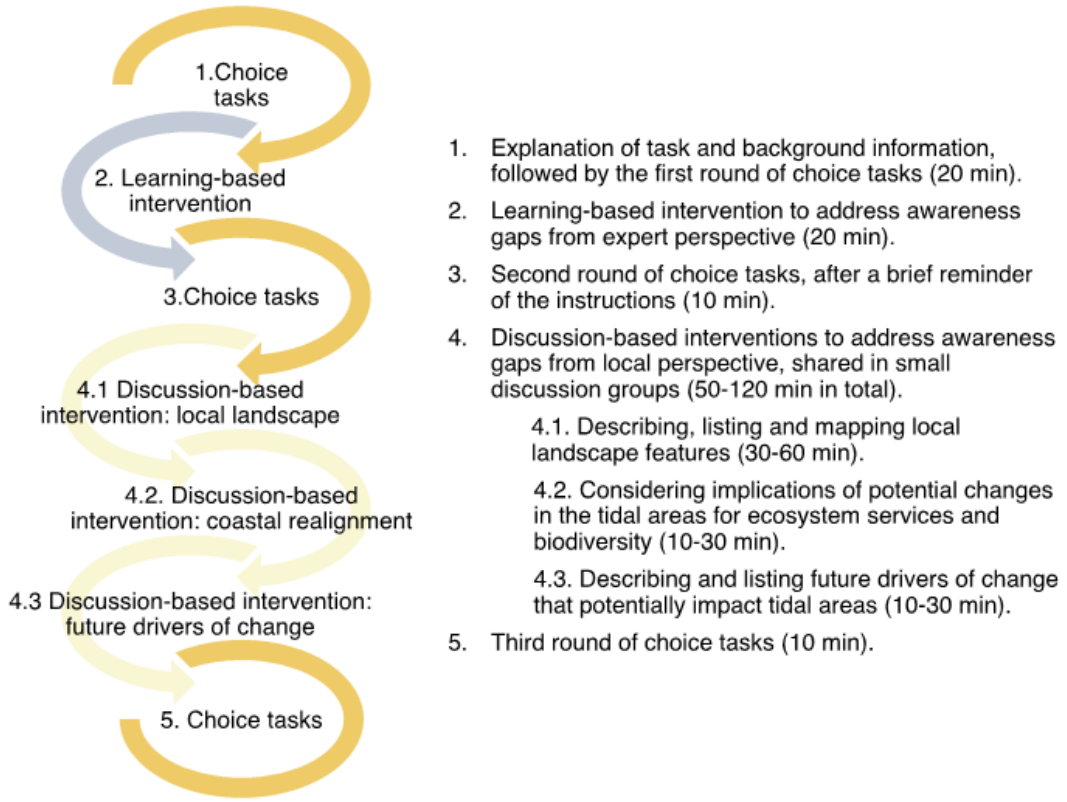


Figure 2. There were altogether five activities in the workshops, three of which were choice tasks (before and after both deliberative interventions).

5.5.2 Addressing awareness gaps through deliberative interventions

The learning-based intervention was delivered in the format of a 15-minute talk on climate change and shoreline ecosystem services in the area. Although expert views were not explicitly addressed, it was made clear that the workshops were a research-driven initiative and the presentation was given by a researcher. The content of the talk (Box B2 in Appendix B) was identical and delivered by the same team member in all workshops. Participants were given limited opportunity to ask questions during or after the intervention. Instead, the presenter followed up questions on an individual basis to avoid vocal or engaged individuals to influence others' perception of the learning-based intervention.

The discussion-based intervention was implemented in groups of 3-7 people and led by a team of relatively inexperienced but trained facilitators. The discussion-based intervention consisted of three parts that focused on the natural environment, coastal area and future drivers of change, which are explained in detail in Table B1 in Appendix B. Groups discussed and recorded important aspects of the natural environment in their local area (Step 4.1 in Figure 2); discussed the implications of managed realignment in the local shoreline (Step 4.2), and potential future drivers of change that would impact the shoreline (Step 4.3). Analysis of the discussions for the first two parts (4.1 and 4.2 in Figure 2) are not covered here, instead, they were analysed and presented earlier in 4.3. The drivers of change mentioned during the third part of the discussion-based intervention (Step 4.3 in Figure 2) were assigned codes based on the social-ecological systems (SES) framework (Ostrom 2009), to determine which SES variables were discussed the most during the intervention. A detailed description of this SES analysis is in Appendix E.

5.5.3 Choice experiment design

A choice experiment was implemented at three stages in the workshop process (see Figure 2), specifically before and after both deliberative interventions in the workshop. For each stage a separate model was estimated, and the WTP obtained are used to determine the effects of both deliberative interventions. The same choice experiment was implemented using a standard face-to-face interview approach, and comparing face-to-face interview estimates with the workshop estimates allows us to identify the impact of the valuation format on participants' preferences. Participants were also asked to complete a follow-up questionnaire after the third round of choice tasks to gauge perceived differences in preference and choice certainty.

Attributes for the choice experiment were chosen based on the findings of the scoping phase (Table C1 in Appendix C). Furthermore, two additional pilot studies were carried out in Alloa prior to the main study to support the design of the choice experiment. The purpose of the first additional pilot was to test and improve the clarity of the choice tasks, and to determine appropriate levels for the monetary attribute (n=17). The purpose of the second additional pilot was to generate parameter estimates for the attribute levels

based on a fractional factorial design generated in NGene (version 1.1.1), which could then be used to generate an efficient statistical design (n=25, Box C1 in Appendix C). The design used for the main study is a *D*-efficient statistical design, generated in NGene. The statistical design consists of four different sets of choice cards, with six cards in each set. The interview participants were randomly assigned to one of the four sets. In the workshops, a different set was assigned to each of the five events. The first event was undersubscribed; therefore, the same set of choice cards was used in fifth event. The workshop participants completed the same set of choice cards at all three stages in the workshop, but the order of cards and options in each card were shuffled to avoid sense of repetition.

Each choice card has three shoreline options. One out of the three is the status quo, and the two remaining options involve changes in terms of both the shoreline attributes and the monetary attribute. The three shoreline attributes are managed realignment, conservation actions, and recreational paths. The monetary attribute is a monthly donation during a period of five years to the Inner Forth Landscape Initiative, which implements landscape improvement projects, including habitat restoration, in the area. A donation-based attribute was selected instead of a tax-based attribute to include participants who are not employed. The attributes are described in full detail in Table C1 in Appendix C.

In the choice experiment the changes in the shoreline attributes occur in terms of magnitude of change and in terms of distance from Alloa. We distinguish four levels for each attribute: short distance, long-distance, medium and maximum level. The magnitude of change is low in the short-distance and long-distance attributes, medium in the 'medium' level, and high in the 'maximum' level (Table 2). The distance from Alloa is short for 'short-distance' level, long for 'long-distance' level, whereas in 'medium' and 'maximum' there are sites at short and long distance. The levels are represented by a set of shoreline land parcels, where the shoreline attribute in question would change.

Name	Magnitude of change	Distance	Description of attribute level
- Short-distance	Low	Short	Land parcels only near resident areas of Clackmannanshire
- Long-distance	Low	Long	Randomly selected combination of an equivalent number of land parcels that are far away from the resident areas, so that the effect of distance to the residence on attribute preference can be assessed.
- Medium	Medium	Both	Changes occur at both short and a long distance, in twice as many land parcels as in levels 1 and 2, with half of the parcels nearby and half of the parcels far away.
- Maximum	High	Both	Changes occur in all feasible land parcels. The exact number of sites for this level varies somewhat between attributes, depending on the number of sites where the attribute actually can change.

Table 2. Description of attribute levels in the choice experiment.

We expect short-distance attributes to be preferred over the long-distance attributes, as participants are expected to prefer increases in cultural and regulating ecosystem services closer to where they live. Participants are also expected to prefer medium levels over short-distance or long-distance, and maximum level over medium level, because participants are expected to prefer increases in magnitude of ecosystem services.

All participants, regardless of the format (face-to-face interview versus workshop setting), were given the same information and instructions before completing the choice tasks (Box C2 in Appendix C). In the choice tasks, each option is represented by a map and a set of five statements to describe its implications in terms of breeding bird numbers, flood and erosion risk, access, recreational disturbance, habitat availability and ecological status of tidal areas. The donation involved is also stated for each option. The facilitator described the differences between the three options to reduce cognitive burden for the participant. Face-to-face interview participants were also asked which attributes affected their choice after each task, or at the end of the interview, depending on the time available (Figure C1 in Appendix C).

For measuring the impact of study format and deliberative interventions, we estimate four separate random parameter logit (RPL) models (Train 2009): the face-to-face interview, and three stages during the workshops. Applications of RPL models have shown that this model is superior to the standard multinomial logit model in terms of overall fit and accuracy of welfare estimates (e.g., Provencher and Bishop 2004). RPL models account for preference heterogeneity and repeated choices (Train 2009) and allow for deriving both mean WTP and WTP variance across individuals, giving us the opportunity to compare the impact of deliberative interventions on the entire WTP distribution. We dummy-coded the attribute levels in the model and used the 'short distance' attribute level as the reference point. We include random parameters for all attribute levels, except for the monetary attribute, because this is known to substantially inflate the variation in value estimates (Hensher et al. 2005). For each attribute level, we draw 1000 times from a uniform distribution using Halton draws. We applied the Poe test (Poe et al. 2005) to compare the mean WTP estimates, and the Mann-Whitney test (Mann and Whitney 1947) to compare the WTP distributions between formats and deliberative interventions.

5.6 Results

5.6.1 Scoping phase: identifying awareness gaps

Many of the scoping phase participants held rich local knowledge, built on life-long experiences of living by the Forth: "The river Forth has always been part of my life. It should be cared for and looked after". For others, the connection was less personal, and they had less local knowledge regarding the river, but nevertheless often a sense of responsibility for protecting local wildlife: "I am aware that there are wetlands but I'm not sure where they are. They are definitely important, poor birds have flown thousands of miles". The latter quote above represents many of those that were interviewed who had little local knowledge of the shoreline areas. Many were not even aware that there are habitats for birds (22%) and fish (32%), however, 93% and 86% (respectively) agreed it

was important to have habitats for wildlife in the local tidal areas (Tables A1-A4 and Boxes A4-A5). The details of the scoping results are in Appendix A.

Three out of 31 asked disagreed with the scientific view that Inner Forth is likely to experience climate change in the coming decades (Figure A1 in Appendix A), whereas no one disagreed with the view that nature on the shorelines should be protected and restored. For ecosystem services, many were not aware that tidal marshes and flats reduce erosion (38%) and regulate flooding (32%), but most participants agreed that they are important to have in the local area (83% and 93%, respectively).

5.6.2 Valuation phase: addressing awareness gaps and measuring impact

Altogether 109 participated in the workshops and 98 in the face-to-face interviews during the valuation phase (Figure 3). The response rates were 7% in workshops and 28% in face-to-face interviews. The population samples for both formats were representative of the Clackmannanshire population, but the sample for the face-to-face interview was somewhat more representative in terms of household ownership, age and employment (Table D1 in Appendix D). Amongst those participants who are employed, people with professional roles (e.g. engineering, education, academia and IT) were overrepresented and those with elementary roles (e.g. property maintenance) were underrepresented in both formats (Table D2 in Appendix D). The majority of participants live in Alloa, within short walking distance from the areas where participants were recruited, interviewed and workshops were held (Figure 1)[5]. Overall, there are no considerable differences in geographic distribution of participants between workshops (Figure D1 on the left) and interviews (Figure D1 on the right). Workshop participants lived in Clackmannanshire longer on average (28 years) compared to face-to-face interview participants (24 years). About 20% of workshop and 15% of interview participants live in South-East parts of Alloa, which were amongst the most deprived 10% areas in Scotland in 2016 (Scottish

[5] Out of 109 workshop participants, 108 were asked for their postal code, of which 17 were not recognised. Out of 98 interview respondents, 97 provided their postal code, and 11 postal codes were not recognised.

Government 2016a). About 35% of workshop and 40% of interview participants live in areas of South-East Alloa ('bottom end'), Clackmannan, Sauchie, Tillicoultry and Tullibody, which fall within the 20% most deprived areas in Scotland. Five percent of workshop and two percent of interview participants live outside the Clackmannanshire area in Falkirk, Kincardine and Bridge of Allan. Full details of the demographics are included in Appendix D.

Figures 3a-3d. Workshop participants taking part in learning-based interventions (Figure 3a, top left) and discussion (Figures 3b-3d, right and bottom left)

Deliberative interventions

Participants shared a lot of knowledge on how the social, economic and political settings impact the Inner Forth (Figure E4 in Appendix E); and how stakeholder actions impact one another (Figure E6), the river system, and the stakeholder variables (Figure E5). They demonstrated limited knowledge on how local stakeholders are involved in governance (Figure E5). Findings from the first and second part of the deliberative interventions are presented in 4.3.4. A detailed description of the findings from the third part on 'future drivers of change' are in Appendix E.

Estimation results and mean WTP estimates

The dependent variable in our model is the choice of a shoreline option out of three options on a choice card by the Inner Forth resident. We present the RPL model estimates and mean WTP estimates for the separate formats and stages in Table 4. The adjusted McFadden pseudo R^2 values are 0.17 for the face-to-face interviews, 0.39 before interventions in workshops, 0.43 after the learning-based intervention, and 0.40 after both interventions (see also Table 4), which are good values for a choice model (Louviere et al. 2003).

The Poe (2005) and Mann-Whitney (1947) results are reported in Table 3. The p-values show that there is a statistically significant difference in mean and distribution of WTP between formats (interview and workshop) for all attribute levels ($p<0.05$), except the mean WTP for long-distance and medium conservation actions and long-distance recreational paths, and WTP distribution for long-distance conservation actions. The difference is significant ($p<0.05$) also after the learning-based intervention for all attribute levels except the mean WTP for maximum recreational paths, and the distribution of WTP for maximum conservation actions and long-distance recreational paths. After the discussion-based intervention, the mean and distribution of WTP estimates are significantly different for all attribute levels ($p<0.05$).

In the model for the face-to-face choice experiment, and the model for the workshop choice experiment before interventions, there are six statistically significant ($p<0.05$) coefficients; after the learning-based deliberation there are five statistically significant coefficients ($p<0.05$); and after both interventions, there are only three statistically significant ($p<0.05$) coefficients left. Stated non-attendance to donation was 40% during workshops and 24% in the interviews amongst those who were asked (100% were asked in workshops, and 95% in interviews). Donation (65%) and an overall impression of shoreline attributes (47%) were mentioned as the most common motivations to determine participants' choices in the face-to-face interviews (Table F1 in Appendix F). Altogether 82% considered themselves when making a choice; 68% their family; and 75% the community.

		Format		Learning-based intervention		Discussion-based intervention	
Attributes		**Mean**	**Distribution**	**Mean**	**Distribution**	**Mean**	**Distribution**
	Status quo	0.000	0.000	0.000	0.000	0.000	0.000
Managed realignment	**Long distance**	0.000	0.000	0.000	0.000	0.000	0.000
	Medium	0.000	0.000	0.000	0.000	0.000	0.000
	Maximum	0.000	0.000	0.000	0.000	0.000	0.000
Conservation actions	**Long distance**	0.303	0.023	0.000	0.000	0.000	0.000
	Medium	0.378	0.000	0.000	0.000	0.000	0.000
	Maximum	0.000	0.000	0.000	0.014	0.000	0.000
Recreational paths	**Long distance**	0.232	0.000	0.000	0.011	0.000	0.000
	Medium	0.000	0.000	0.000	0.000	0.000	0.000
	Maximum	0.000	0.000	0.303	0.000	0.000	0.000

Table 3. The Poe test (mean) and Mann-Whitney test (distribution) p-values on difference in WTP between face-to-face interview and workshop, before and after learning-based interventions (middle), and before and after the discussion-based intervention (right). The Poe and Mann Whitney test p-values represents the probability that the differences between formats and stages are not different.

		Face-to-face interviews			Workshops								
					Before interventions			*After learning-based interv.*			*After both interventions*		
Attribute	**Level**	**Coeff. (S.E.)**	**St. dev. (S.E.)**	**Mean WTP**	**Coeff. (S.E.)**	**St. dev. (S.E.)**	**Mean WTP**	**Coeff. (S.E.)**	**St. dev. (S.E.)**	**Mean WTP**	**Coeff. (S.E.)**	**St. dev. (S.E.)**	**Mean WTP**
Status quo	--	1.010 (0.927)	4.045***	£5.83	-2.582* (1.319)	7.971***	-£2.22	-9.742*** (3.022)	17.055***	-£6.31	-10.591*** (2.965)	13.237***	-£10.88
Managed realignment	**Long dist.**	0.893*** (0.342)	0.912	£6.59	0.761** (0.381)	0.020	£2.35***	0.161 (0.410)	0.046	-£0.75***	-0.612 (0.432)	1.498*	-£1.53***
	Med.	1.435*** (0.378)	1.063*	£10.07	2.079*** (0.445)	0.015	£6.33***	1.483*** (0.449)	0.058	£3.39***	0.826* (0.439)	0.309	£2.10***
	Max.	1.874*** (0.397)	0.438	£14.16	2.359*** (0.457)	1.111	£7.69***	2.345*** (0.509)	1.733**	£6.41***	1.437*** (0.445)	0.864	£4.46***
Conservation actions	**Long dist.**	0.425 (0.385)	1.761***	£3.59	1.069** (0.436)	0.265	£3.35	0.850* (0.484)	0.135	£1.50***	-0.584 (0.459)	0.104	-£1.59***
	Med.	0.796** (0.370)	0.710	£4.16	1.465*** (0.435)	0.101	£4.29	1.093** (0.486)	0.117	£1.56***	-0.229 (0.455)	0.017	-£0.74***
	Max.	1.259*** (0.362)	0.400	£8.78	2.039*** (0.448)	0.852	£6.34***	2.077*** (0.538)	1.907***	£5.20***	0.528 (0.471)	1.596**	£1.52***
Recreational paths	**Long dist.**	0.451 (0.394)	0.892	£1.15	0.601 (0.460)	1.666**	£1.44	0.557 (0.511)	0.732	£0.09***	-0.227 (0.476)	1.435*	-£0.61***
	Med.	0.627* (0.334)	0.471	£3.83	0.431 (0.351)	1.019	£1.21***	0.054 (0.378)	1.457**	-£1.09***	-0.790** (0.398)	1.661**	-£2.33***
	Max.	0.815** (0.342)	0.543	£5.93	0.507 (0.364)	1.184*	£1.68***	0.835* (0.430)	1.646**	£1.78	-0.140 (0.420)	2.094***	-£0.13***
Donation	--	-0.061 (0.040)	--	--	-0.241*** (0.051)	--	--	-0.264*** (0.057)	--	--	-0.347*** (0.065)	--	--
Adj. Pseudo R^2		0.17			0.39			0.43			0.40		
Participants		98			109			109			109		
Number of observations		551			633			645			647		

Table 4. Random parameter logit estimates for choice in face-to-face interviews and workshops. The reference category is the short-distance option for all attributes. The uncertainty of the coefficients is in parentheses. Significant relationships between utility and choice (coeff.) and significance of heterogeneity (st. dev.) are indicated at 1% (***), 5% (**) and 10% (*) level.

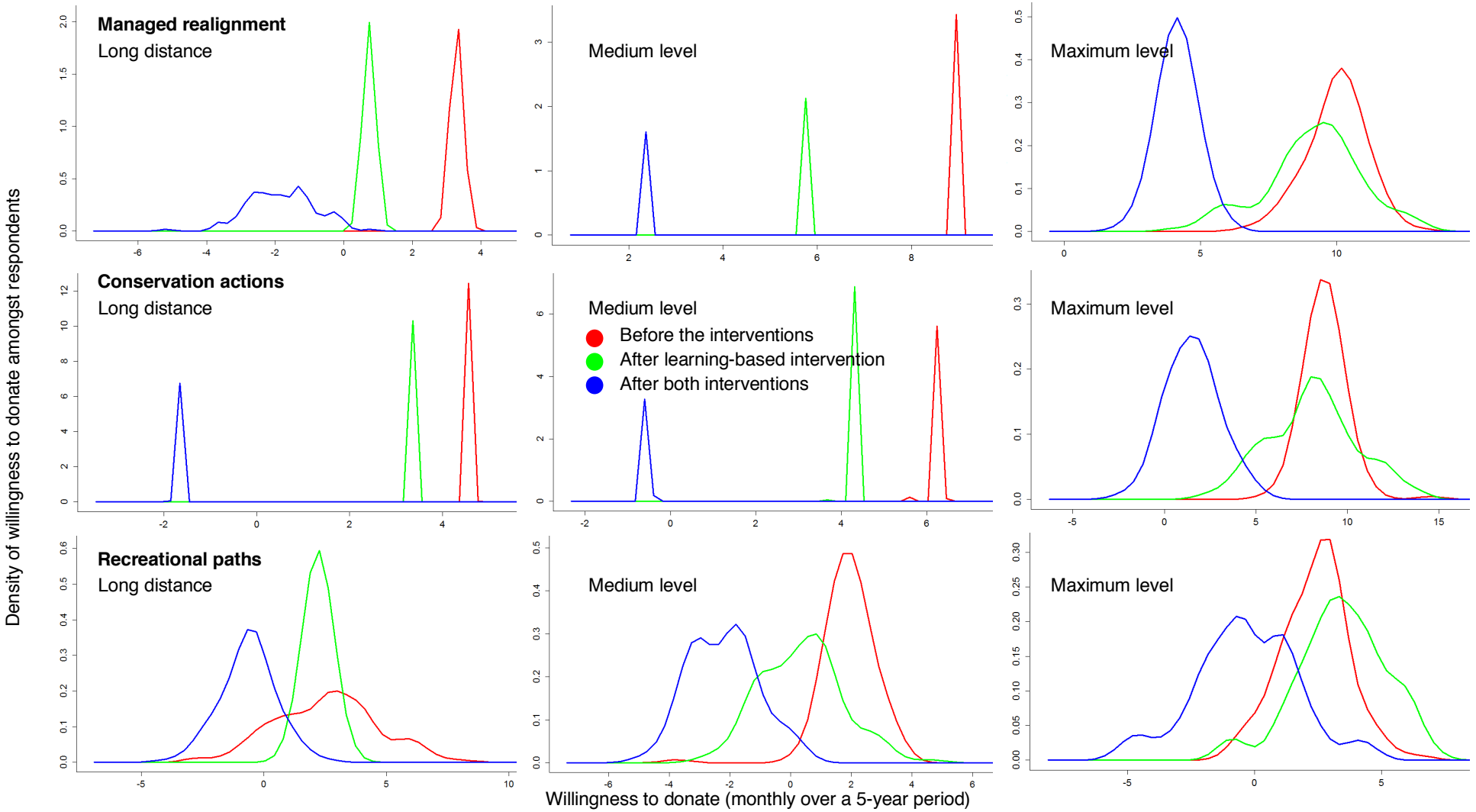


Figure 4. Distribution of WTP in the workshops derived from the RPL model outputs. With the curves being the density functions of WTP, the y-axis represents the height of the density function. The intervals at which WTP is estimated on the x-axis have been adjusted differently for each sub-figure [a], to improve display of the relative difference in distribution between the three stages.

[a] the intervals at which WTP is estimated on the x-axis: Top left 0.2, top middle 0.02, top right 0.6; centre left 0.02, centre middle 0.05, centre right 0.8; bottom left 0.6, bottom middle 0.5, bottom right 0.6

Effects of the valuation format on WTP and estimation results

We find the mean WTP estimates to be significantly lower for the workshop before interventions than for the face-to-face interviews for all levels of managed realignment, 'maximum conservation actions', and medium and maximum recreational paths (p<0.05). The differences in donation coefficient between the formats suggest that it is not sensible to compare the WTP estimates between the face-to-face and the workshop format, and in Figure 4 we have only included WTP distribution curves from the three workshop choice experiments for this reason.

Effects of deliberative interventions on WTP and choice certainty

After learning-based intervention, we find that WTP estimates decrease significantly for all attributes, except for the status quo and 'maximum recreational paths' (Table 4). After both interventions, WTP estimates are substantially lower for all attributes, except for the status quo. Altogether 47% felt more certain about their choices after the deliberative interventions, whereas 9% felt less certain, and 44% did not think their certainty had changed. In total 36% felt that having more experience in making choices had affected their certainty; 35% because they had learned about others' opinions; 19% because of mapping and discussing landscape values; and 50% for learning more about the shoreline areas. Overall, 35% felt that all deliberative activities had shaped their preferences; 36% felt that one of two had had an impact; and 29% felt that there had not been an impact.

The status quo shoreline

We find a positive statistically insignificant relationship for status quo in the face-to-face interviews, and negative and statistically significant coefficients at all stages of the workshop. After each intervention, the negative impact of the status quo option increases, implying people are moving away from choosing the status quo more and more due to social and individual learning. The learning-based intervention increases preference heterogeneity (Table 4).

Managed realignment of the shoreline

The mean estimates suggest that respondents are significantly (p<0.05) more likely to choose 'maximum managed realignment' than the short-distance option in both formats (Table 4). The 'maximum managed realignment' is the highest ranked attribute level in both interviews and workshops, suggesting it was the most preferred attribute. Participants in both interviews and workshops before the interventions prefer sites further away instead of nearby (p<0.05). After the interventions, this pattern shifts to a positive but insignificant preference for short distance. Preference heterogeneity increases for all levels after the learning-based interventions (Figure 4).

Conservation actions on the shoreline

Interview participants do not have a significant preference in terms of distance to conservation actions (Table 4). In workshops, there is a preference (p<0.05) for conservation actions to occur further away before the interventions, however, after the interventions the difference is not significant. The mean estimates suggest that participants in interviews and workshops before the discussion-based intervention are significantly (p<0.05) more likely to choose the medium and maximum level over the short-distance option, however, after discussion-based interventions this relationship is no longer significant. The preference heterogeneity for paths decreases for all levels after the discussion-based interventions (Figure 4).

Recreational shoreline paths

Face-to-face interview participants prefer more paths (at maximum level) over less (p<0.05), whereas workshops participants do not have preference for having more paths. After both interventions, however, they prefer less recreational paths, but only at the medium level (p<0.05). Overall, the deliberative interventions increase preference heterogeneity for paths, particularly the discussion-based intervention (Figure 4). The mean estimates suggest that there is no significant preference for distance to paths in either interviews or workshops (Table 4).

5.7. Discussion

Our results from the deliberative choice experiments suggest that addressing awareness gaps in a workshop setting improves the environmental valuation process. Nearly half of the participants (47%) felt more certain about their choices, and the majority (71%) felt that at least one of the interventions had shaped their preferences. We find that WTP decreases for all attribute levels (except WTP associated with the status quo) after both deliberative interventions. It remains unclear why WTP decreases: participants potentially consider more carefully how the shoreline attributes weigh up against the donation involved, or overstate their WTP less (Shogren 2006), i.e., hypothetical bias is reduced after interventions. The deliberative interventions also allow for individual learning on how to complete the choice tasks, which appears to increase participants' certainty in making choices for over a third (36%) of the workshop participants.

The findings suggest that the deliberative interventions lead to the emergence of clearer priorities: after deliberations, managed realignment is the most important shoreline attribute, and that it is the magnitude of change that matters more than distance to sites. We find that the number of other statistically significant attribute levels decreases, contrasting the findings of Christie et al. (2006) and Dietz et al. (2009) who observe an increase in the number of statistically significant attributes.

5.7.1 Impacts of addressing awareness gaps from an expert perspective

Our findings suggest that learning-based interventions to raise awareness on local issues from scientific, ecological and policy perspectives played a considerable role in improving the deliberative choice experiments. The learning-based intervention increases self-reported certainty in making choices for 50% of the participants, and reduced inconsistencies in preference between different levels of the shoreline attributes. Before the learning-based intervention, participants prefer managed realignment and conservation actions further away, which contradicts their preference for medium and maximum levels (over the short-distance level) for the same attributes. After the learning-based intervention, participants no longer prefer longer distance.

The WTP distribution curves show that the learning-based interventions shape people's preferences in different ways (Figure 4). Preferences for having medium and maximum levels of the shoreline attributes diverge, apart from 'medium conservation actions'. This finding is different from Shapansky et al. (2008) and Alvarez-Farizo and Hanley (2006) who found deliberation on expert information to converge preferences. This divergence could be explained by some participants being more sensitive to the information provided than others. There was no time to discuss or reflect on the information given in the learning-based intervention, and as a result, some participants may not have been able to digest the information provided. This is indeed the main weakness of the learning-based intervention. Future studies should allow time for discussion on the information provided, as done by Kenter (2016a), Christie et al. (2006) and Robinson et al. (2008).

5.7.2 Impacts of addressing awareness gaps from a local perspective

The discussion-based interventions shaped participants' preferences in terms of magnitude of change, compared to the learning-based intervention. There is evidence that people start preferring less paths compared to more paths (Table 4, $p<0.05$), however, the pattern is not clear or significant for the maximum level. The reason this shift is not statistically significant at the maximum level is perhaps because the preferences are very spread out: the WTP curves suggest that there is almost as much support for maximum level as there is for having less paths. We find a similar trend for conservation actions: participants no longer prefer more conservation over less conservation. This finding is further supported by deliberations during the discussions that refer to concerns over active conservation management. For managed realignment, however, participants continue to prefer more over less even after discussions, although the medium-level is no longer a significant factor in determining choices.

The discussion-based intervention also increased participants' certainty in making choices because of the discussions with others (35%) and deliberating on their priorities for their local landscape (19%). We also observe systemic learning (Kenter 2016a) during the discussions, however, our analysis highlights that they had limited ability to deliberate on

the governance aspects of the Inner Forth (Figures E1, E2 and E4 in Appendix E). Pressures on the river system received a lot of attention in the discussions, and the locals recognised actions taken by stakeholders in the area to have considerable impacts on the shoreline (Figure E3). The discussions also complemented the learning-based interventions by highlighting pressures that were not mentioned before, such as pressures from housing, fracking and pollution (Figure E3).

5.7.3 Differences in shoreline preferences between workshops and face-to-face interviews

The preferences we elicited in the workshops are considerably different from the face-to-face interview results: not only because there are some differences in preference for shoreline attributes in terms of both magnitude and distance, but most importantly, the model fit for the face-to-face interviews is much lower. This is largely because the donation coefficient in the face-to-face interview model (-0.061) is relatively much smaller compared to the workshop models (between -0.241 and -0.347), and consequently, the WTP estimates are statistically insignificant. This difference could be due to the fact that face-to-face interview participants are less sensitive to changes in the donation attribute. Given the identical sampling procedure and similar sample compositions, however, it is more likely that it is the different formats and deliberative interventions that lead to the different ways in which the monetary attribute is considered when making choices. As a result, it is difficult to compare the preferences from the face-to-face interviews with those from the workshops.

4-7.4 Methodological weaknesses

The sample size of this study is still relatively low for the data requirements of choice experiments (Mason et al. 2003; de Bekker-Grob 2015). The main issue arising from the low sample size is that the probability of the differences in value between face-to-face interviews and workshops being due to differences in valuation format is lower, and the probability of samples being different is higher, compared to a study with a high sample size. The sample size issue could be addressed in future studies by using socio-cultural valuation methods with lower sample size requirements, such as landscape visualisation tools (Schmidt et al. 2017), participatory mapping (Alessa et al. 2008) or narrative methods

(Kelemen 2016). As this study has illustrated, the effort, resources and organisation required per participant is a lot higher for deliberative formats compared to shorter formats. Higher sample sizes could also be achieved by developing online platforms for participation that have a built-in space for social deliberation, following the model in online gaming that has been developing considerably in the past decades. Online platforms, however, would only facilitate engaging the digitally native generations, and provide limited opportunities for building interpersonal trust between participants and the facilitators.

The value outputs from face-to-face interviews and workshops could also be different due to self-selection. Although the recruitment of participants was identical for both interview and workshop participants (5.5.1), workshops may have attracted more participants who were willing to invest more time. We attempted to compensate for this by offering a financial compensation to workshop participants.

The research design in this study does not allow us to measure the impacts of individual (Carlsson et al. 2012) and social (Crum et al. 2009) learning separately. Furthermore, it does not allow us to separate the impacts of learning-based and discussion-based interventions. Indeed, it is likely that participants continued to deliberate based on what they heard during the learning-based intervention during the discussion-based intervention, which may have impacted the WTP estimates at the last stage of the choice experiment.

Understanding the relative importance of the underlying mechanisms, such as individual and social learning, and the role of different knowledge systems, such as expert and local, are particularly interesting questions for research. We argue here, however, that they are not priority issues from a practical viewpoint. For policy and practice, the practical application of this type of research is that it can help to improve the outcomes from using participatory tools. It is therefore more useful to focus efforts on directly experimenting with and developing valuation formats that improve the outcomes of participation. Although studies that focus on untangling the underlying mechanisms can help in

achieving better valuation outcomes in the long term, deliberative valuations that carefully designed follow-up questionnaires (e.g. Kenter 2016a) in deliberative valuations also have potential in working towards that goal.

5.7.5 Deliberative choice experiments – a tool to support citizen participation in a transition to sustainability

Sustainable transitions, such as managed realignment of the shoreline to manage floods and restore wetland, can be difficult to implement without the support and involvement of local communities (Richardson and Razzaque 2005). We addressed this issue by engaging with a demographically representative group of 267 citizens to understand the social value of managed realignment in the Inner Forth. Achieving a sample of the citizens that was locally representative required a high-effort recruitment technique that minimised selection bias (2014), and a participation fee to attract citizens beyond those who were interested in participating without payment. As a result, we engaged citizens even from the most deprived areas, which is often difficult (Ferragina et al. 2013).

Ecosystem services valuation methods, such as choice experiments (Hanley et al. 1998), present a promising tool for engaging citizens in local governance to support a transition towards sustainability. Our findings highlight that many citizens held little knowledge about the Inner Forth shoreline, and the local and global pressures it is facing, which limited their ability to make informed choices. We integrated deliberation into the choice experiment to help raise awareness and build ability to participate in sustainable planning (Persson 2013). We also found deliberations to enforce the notion of a sustainable transition both qualitatively and quantitatively. Participants preferred the status quo less after the learning-based intervention, and it becomes a significantly (p<0.01) negative factor in people's choices. The discussions, described in the Appendix E, also support the notion of a transition from the current state. Furthermore, participants preferred having more managed realignment instead of less, and it was the highest ranked shoreline attribute. Even after deliberations, participants were still WTP a considerable donation of £4.46 monthly over a five-year period.

Citizen participation in local planning, such as managed realignments of the shoreline to adapt to rising seas, are essential for successful implementation of sustainable transitions on local level. Our findings suggest that deliberative formats of choice experiments can be used to engage citizens in planning these sustainable transitions. Our case study shows that citizens show considerable and consistent support for managed realignment before and after deliberations in the Inner Forth.

5.7.6 Conclusion

In this study, we asked whether addressing awareness gaps from both local and expert perspectives impacts people's stated willingness to donate towards shoreline changes in the Inner Forth. We find that WTP for regulating and cultural ecosystem services is significantly lower after the deliberative interventions, however there is still considerable support and WTP for managed realignment. Furthermore, we find the deliberative framework to environmental valuation to improve the valuation outcomes from a sustainability perspective: clearer priorities emerged, model fit to considerably improved, participants felt more certain about their choices, and they became more resistant to maintaining the status quo shoreline. Our findings highlight the importance of addressing awareness gaps and suggest that deliberative formats of participatory tools like choice experiments are a promising way to engage stakeholders in sustainable transition on local level. More future research is needed to develop deliberative formats of existing participatory tools, and work together with policy and practice to identify and address awareness gaps as part of the participatory process.

CHAPTER 6

Discussion

This discussion chapter has five parts. The first discussion of findings (6.1) considers the implications of the citizen engagement gap for adaptation governance in light of the empirical material presented here. The second discussion of findings (6.2) examines how this thesis contributes empirically and methodologically to our understanding of citizen engagement in adaptation, with a focus on the use on integrated and deliberative valuation approaches. In 6.3, the limitations of this study are discussed in terms of both the emerging adaptation governance horizon and the participatory qualities of the valuation methodology. In 6.4, the implications of the participatory insights from this thesis are considered for future applications of valuation and citizen engagement. I conclude the thesis in 6.5 by outlining the main contributions to knowledge on adaptation and the use of valuation methodologies for citizen engagement.

6.1 First discussion of findings: Implications of the citizen engagement gap for adaptation governance

With the growing advocacy in international policy (e.g. Paris Agreement 2014), governance scholars (Brink and Wamsler 2018; Klein et al. 2017; Adger et al. 2009; Juhola

and Westerhoff 2011; Lebel et al. 2006) and citizens themselves (Healey et al. 2006) to mainstream citizen engagement in adaptation, this thesis contributes to adaptation literature by examining the governance implications of the citizen engagement gap, based on evidence from the local scale case study of the Inner Forth. The observed lack of citizen engagement (3.4.3), which was also reflected in their limited ability to deliberate on the governance aspects of the Inner Forth (5.6.2 and Figure E1 in Appendix E), has implications for the legitimacy of adaptation governance (6.1.1), climate risk awareness (6.1.2) and consensus-building (6.1.3).

6.1.1 First implication of the citizen engagement gap: legitimacy of adaptation governance

The first governance implication of the citizen engagement gap regards legitimacy of decision-making processes, which has so far received limited empirical attention in the adaptation literature (Mees et al. 2014). Although the empirical material here does *not* suggest that there is active public mistrust towards local authorities in implementing adaptation (largely because of unawareness of local climate risks), there is general indication of poor 'throughput legitimacy' (Mees et al. 2014) as citizens described feelings of being overlooked and emphasise the importance and benefits of increasing citizen engagement (3.4.3). Scholars in adaptation literature suggest that increasing throughput legitimacy enhances support for shoreline adaptation by improving social trust (Jones et al. 2015) and by alleviating scepticism towards nature-based solutions (Myatt et al. 2003), although increased participation does not necessarily improve the acceptance of adaptation actions (Mees et al. 2014). Furthermore, others (Brink and Wamsler 2018) suggest nature-based adaptation to in fact foster citizen engagement.

In light of the meta-analysis of 47 polycentric and participatory governance case studies by Newig and Fritsch (2009) that shows stakeholders' attitudes to predominantly shape the environmental outcomes of decision-making, citizen engagement would also potentially increase the acceptance of adaptation actions in the public domain. In the case of the Inner Forth this would not be the static 'hold-the-line' option preferred by the majority of landowners (3.5.1). By showing that citizens living on the shores of the Inner

Forth are in favour of the nature-based solution of managed realignment (3.4.1, 5.6.2) that is increasingly being promoted by scholars (e.g. Jones et al. 2012), this study contributes to the empirical body of literature (e.g. Luisetti et al. 2011; Boyer-Villemaire et al. 2014; Roca and Villares 2012; Myatt-Bell et al. 2002; Myatt et al. 2003; Rulleau and Rey-Valette 2013) on stakeholders' attitudes towards coastal adaptation options. Whereas this body of literature so far emphasises principles of effectiveness and instrumental benefits to motivate citizens' support for e.g. nature-based adaptation (e.g. Myatt-Bell et al. 2002; Luisetti et al. 2011), which hypothetically would shape the outcomes of decision-making in a polycentric governance arrangement if in accordance with the evidence by Newig and Fritsch (2009), this study shows that the inclusion of citizens has the potential to bring other-regarding moral principles and biocentric values (see Table 3 in 4.3.4) into the decision-making process.

6.1.2 Second implication of the citizen engagement gap: unawareness of climate risks on local level

Despite national-level efforts to advise the implementation of adaptation measures in Scotland (Adaptation Scotland 2016), this thesis presents (partly tentative) locally derived evidence that the long-standing issue of risk (un)awareness amongst land owners, citizens and some of the organisations involved in shoreline management (3.4.1, 5.6.1, Appendix A) continues to hinder adaptation efforts, in line with the recent nationwide findings of Porter et al. (2015). Although knowledge of climate risks does not on its own translate into adaptation action (Wamsler and Brink 2014), scholars have documented risk awareness to foster citizens' motivation to engage (Abel et al. 2011), create a culture of anticipatory (in addition to reactionary) adaptation practice (Dumaru 2010), gain public support (Roca and Villares 2012) and foster collaborative action between local authorities and citizens (Brink and Wamsler 2018). In the Inner Forth, increased climate risk awareness in the public domain could potentially drive policy towards adaptation action where locally derived evidence of climate risks (Swart et al. 2014; Abel et al. 2011) is not sufficient to justify action (Table 2 in 3.4.1).

6.1.3 Third implication of the citizen engagement gap: formation of shared values

By drawing together the theory of deliberative democracy (O'Neill 2001; Escobar 2017; Jacobs 1997) with empirical coastal governance studies that call for deliberative governance to resolve conflicting values (Glavovic et al. 2016; Lloyd et al. 2013; Moser et al. 2012; Wynberg and Hauck 2014), I identify lack of consensus-building to be a critical implication of the citizen engagement gap. Authors across the disciplines of participatory governance (e.g. Akompab et al. 2016), valuation (Vatn 2009) and participatory enquiry (Nabatchi and Leighninger 2015) literature emphasise the importance of participatory methods that support consensus-building. In particular, a recent surge of ecosystem services valuation literature on the concepts of shared, plural and cultural values (e.g. special issue edited by Kenter 2016b, Irvine et al. 2016) suggests that a key outcome of deliberative engagement of citizens is the formation of shared values. Kenter defines shared values as overarching or context-specific "values we hold in common, as communities, cultures and societies" that are formed through a "long-term process of socialisation" in a broader context, or more specifically "over a shorter period of time through shared social and deliberative processes" in a valuation context. This definition is different from earlier definitions of shared value, such as equating shared values with public values (Sagoff 1986), in the sense that it emphasises the importance of the process of articulating values in forming the valuation outcomes. Although the participatory design here does not explicitly prompt negotiation or formation of group priorities in the latter sense of Kenter's definition, however, several values (3.4.1, 4.4.1, 5.6.2) can readily be identified from the group discussions that were emphasised by a high proportion of the twenty groups and often led to agreement between participants (e.g. protection of nature and resistance to housing development and fracking).

6.2 Second discussion of findings: Closing the citizen engagement gap in adaptation governance

In this part I examine how the research contributes to the understanding of citizen engagement in adaptation in terms of the emerging polycentric governance context, and the methodological choices that shape its quality and outcomes. First, I discuss the potential to align policies at higher levels to support polycentric governance based on the empirical insights (6.2.1). In the latter two sections, I outline the significance of the participatory process developed here for two schools of environmental valuation: integrated (6.2.2) and deliberative monetary valuation (6.2.3).

6.2.1 Unfolding of polycentric adaptation governance

Against the backdrop of an increasing trend of adaptation being governed on local to regional scales (Huitema et al. 2016; Ford et al. 2011), with scholars (Lebel et al. 2016); Berkes 2004; Abel et al. 2011; Akompab et al. 2013) advocating such polycentric approaches to enable effective action, the empirical evidence of emerging local-level shoreline institutions and informal governance structures in the Inner Forth contributes to discussions that describe and analyse the unfolding of polycentric governance.

The first important characteristic of these emerging institutions is that the spectrum of stakeholders engaged in adaptation is widening (3.4.3). The rationales underpinning this development can be examined in view of related policy areas, such as freshwater river restoration and the implementation of Water Framework Directive, where scholars (e.g. Koontz 2014) have observed local partnerships to have emerged in response to a lack of trust in government agencies, coupled with an increased interest in wider stakeholder engagement. Whereas the empirical evidence from the interviews with stakeholders in the Inner Forth do not support the former, the latter motivation does resonate with my observations in the Inner Forth. The widening of the spectrum of stakeholders engaged is also potentially beneficial for adaptation in light of the empirical evidence from participatory governance literature: building up collaborative institutions and trust

between the actors has been observed to be slow and time-consuming (Ansell and Gash 2008; Lebel et al. 2004). Furthermore, theory on adaptation mainstreaming (Wamsler 2017; Moser and Ekstrom 2010) underscore the importance of institutional settings in enabling the integration or 'mainstreaming' of adaptation policy (Wamsler et al. 2017; Wamsler 2017).

Similarly to other landscape partnerships in the United Kingdom, the emerging collaborative shoreline institutions rely on short-term funding (3.4.3) that require delivery of short-term projects (Heritage Lottery Fund 2017). Although Anguelovski and Carmin (2011) describe lack of resources to foster innovation and entrepreneurship in adaptation, systemic lack of funding in the United Kingdom (driven by the austerity cuts over the past decade) has now surpassed lack of risk awareness as the most important nation-wide barrier to implementing adaptation (Porter et al. 2015). In terms of public policy, the recently introduced second phase of the Land Use Strategy for Scotland that sets out the land use policy for Scotland in 2016-2021, may potentially be used to leverage funding for collaborative adaptation action to deliver land-based adaptation. The Land Use Strategy has so far been applied to support stakeholder engagement in other policy contexts, to develop shared visions and action plans in the landscapes of Stirling Carse (Stirling Council 2017) and seascapes of Shetland (NAFC Marine Centre 2015).

The decision to leave the European Union creates a policy vacuum for mechanisms to support participatory and polycentric modes of governance, such as the mandated participatory planning in the implementation of EU directives (Newig and Koontz 2014). An example of a sector-specific policy vacuum is the agricultural subsidy system that will be transposed to national level in the coming decades. The livelihoods of all farmers interviewed in the Inner Forth are dependent on agricultural subsidies (3.4.1), reflecting the national pattern of full-time farms with over £25 000 output making a loss of £25 500 on average without the Common Agricultural Policy (CAP) payments in 2015 (Scottish Government 2017b). Currently, the criteria for subsidy payments for agricultural land use management is based on agricultural and environmental goals on national and EU level (Kettunen et al. 2014), making it less important for farmers to engage in local governance:

in Scotland in 2016, 19 674 businesses in rural areas received £648 million in CAP payments (Scottish Government 2017a), of which 74% were direct income support under the 'Basic Payment Scheme' to maintain production activities, and the remaining 26% were paid under the agrienvironment or rural development schemes (based on priorities for land management that are determined at the national level). Although the farmers interviewed did not explicitly discuss whether the subsidy scheme plays a role in their motivation to engage in shoreline governance (3.4.3), it was identified to be a major factor for why farmers hold contrasting attitudes towards the adaptation options promoted by locally active organisations and preferred by citizens (3.4.1), which workshop participants also recognised to be potentially problematic for the implementation of adaptation (3.4.3).

6.2.2 Role of value framings in citizen-oriented integrated valuation

The findings of the value framing comparisons produced in the workshops (4.3) broadly resonate with recent developments in the theory of participation (Reed et al. 2017; De Vente et al. 2016; Brooks et al. 2013; Ansell and Gash 2008) on the importance of design in determining the outcomes of participation. In the field of ecosystem services valuation, the results give further weight to growing calls to use plural valuation approaches to articulate different world views (Martin-Lopez et al. 2014; Jacobs et al. 2018, Díaz et al. 2015; Pascual et al. 2017; Saarikoski et al. 2016; Czembrowski et al. 2016; Lo and Spash 2013; Langemeyer et al. 2015). In other words, the participatory qualities of many commonly applied methods for valuation, such as participatory GIS (Brown and Donovan 2014) or choice experiments (Hanley et al. 1998) may not be broad enough in their framing to be used on their own to include plural world views. The literature on integrated valuation so far, however, does not explicitly consider valuation methodologies from a citizen perspective (apart from the exception of Tadaki et al. 2017). This thesis bridges this gap by producing dichotomous comparisons of five value concepts (space, use, ethical position, expression and process) for which (partly tentative) empirical evidence (4.1) suggests value framings to emphasise different social values. This approach departs from integrated valuation conceptualisations (Pascual et al. 2017) and applications (Martin-Lopez et al. 2014; Jacobs et al. 2018) that focus on comparisons of different

disciplinary approaches (e.g. economic versus ecological value). The findings I produce using a more citizen-oriented framework, however, can be clustered and interpreted against the three pillars of sustainability (Daily et al. 2000; Fanny et al. 2015) on which most integrated valuation studies build on:

- Ecological world views are emphasised by framings based on non-use (4.3.1, e.g. appreciation), and framings that allow special importance to be placed on biocentric viewpoints (4.3.3, e.g. space for nature).

- Socio-cultural world views are emphasised through qualitative expressions of principles and importance (4.3.4, e.g. story-telling), as well as deliberation on values (4.3.5, e.g. group discussions), and placing special importance on benefits to people (4.3.3, e.g. green spaces to enjoy).

- Economic world views are emphasised through use-based (4.3.2, e.g. visits), spatially explicit (4.3.1, where) and quantitative (4.3.4, e.g. scoring or WTP) measures that better capture the benefits that individuals derive from different places in their day-to-day life.

6.2.3 Deliberative valuation in building adaptation capacity

Similarly to other studies on citizens' perceptions of nature-based shoreline adaptation (Roca and Villares 2012; Myatt-Bell et al. 2002), citizens living on the shoreline hold little knowledge about the shoreline, and the pressures it is facing (5.6.1). It is in this empirical context that this thesis examines the consequences of knowledge building, the foundational rationale for participatory enquiry (Fals-Borda and Rahman 1991; Reed et al. 2008; Weber and Christopherson 2002; Crosby 2003), on the outcomes of citizen engagement. The participatory valuation process developed here contributes to the limited body of literature (Petts 2007; Koontz 2013) on how effective deliberation with stakeholders can be achieved to build adaptation capacity (Abel et al. 2011; Glavovic et al. 2016; Hobson and Niemeyer 2011; Tippet et al. 2005; Lebel et al. 2016). The observed

improvements in participants' confidence to participate (5.6.2), reductions in preference inconsistencies (5.7.1) and emergence of clearer priorities (5.7.2) suggest that the deliberative approach developed here considerably shapes and improves the valuation outcomes, and thereby provides concrete measures to support the broader premise that deliberation helps to build citizens' ability to engage in adaptation governance.

By differentiating and including both local and expert knowledge in accordance with the functionalist theory of participation (Malinowski 1944; Radcliffe-Brown 1935), the deliberative approach developed here contributes to the deliberative valuation literature (Lienhoop and Macmillan 2007; Kenter et al. 2016a; Christie et al. 2006; Kenter et al. 2011) by showing how local knowledge building is particularly important in increasing the confidence of participants (5.6.2) and by covering potentially pivotal topics (e.g. fracking) which expert knowledge may not draw attention to (Appendix E). The gaps in expert knowledge denote the conflicting knowledges (Fischer 2000) that have received attention in the sociological literature on risk. Although the deliberative interventions developed here do not integrate different knowledges, the complementing nature of local and expert knowledge concurs with calls by scholars (Raymond et al. 2010; Huntington et al. 2002; Olsson and Folke 2001) to advance deliberative methods that achieve knowledge integration.

6.3 Methodological limitations

In light of the broader governance context of the Inner Forth, the analysis on informal governance lacks in coverage because the private sector was not included. In particular, Grangemouth, one of Europe's largest petrochemical complexes, is the industrial heart of the Inner Forth, which together with other port and manufacturing activities has shaped the shoreline considerably in the past centuries (Smout and Stewart 2012). The importance of the private sector is further accentuated by empirical evidence presented here on citizens' perceptions (3.4.3, Appendix E), in line with observations by scholars

on the growing demand for private sector to engage in adaptation (Huitema et al. 2016; Klein et al. 2017).

The participatory qualities of the valuation methods are potentially weakened by the use of a choice experiment that involved a hypothetical donation to weigh up the relative value of different shoreline options (5.5.3). Choosing donation as the currency for trading-off shoreline attributes introduces several methodological weaknesses. The credibility of the donation estimates is undermined by the fact that participants appear to often overestimate their willingness to donate by choosing options that involve donations that are not realistic (Loomis 2011). This issue is a particularly prominent risk in the interviews and the beginning of the workshops, as WTP decreases for all attribute levels (except status quo) after both deliberative interventions (Table 4 in 5.6.2). Overestimation is a potential issue inherent to all stated preference methods with a currency involving an individual cost. This issue could have been addressed by including a time donation attribute (Higuera et al. 2013) instead of a monetary donation, as some participants suggested (Appendix F), however, time can also be considered to be an individual non-monetary cost. Alternatively, the choice experiment could have only included shoreline attributes that trade-off against one another, like Schmidt et al. (2017) illustrate. Finally, this issue of overestimation could have been overcome by only using other valuation methods, such as scoring, that do not require hypothetical individual contributions, to measure changes in value after deliberations.

The main weakness of the participatory process in terms of building citizens' ability to engage in adaptation, which also sets it apart from analytic-deliberative approaches (Stern and Fineberg 1996; Renn and Schweizer 2009; Fischer 2000), is that there was no time to discuss or reflect on the expert knowledge. As a result, some participants may have not been able to digest the information provided (as the diverging WTP distribution curves in Figure 5 in 5.6.2 suggest). From an adaptation governance perspective, this is a limitation because the use and unfamiliarity with scientific evidence are widely recognised obstacles to implementation (Kirchhoff et al. 2013; Archie et al. 2014; Porter et al. 2015; Stephens et al. 2012). Although there are valuation studies that include discussion on

expert knowledge (Kenter 2016a; Christie et al. 2006; Robinson et al. 2008), valuation as a tool for participation offers limited opportunities for more critical modes of engagement, which scholars (Aylett 2010; O'Neill and Spash 2000) argue are important in adaptation. From a sociological perspective, the basis for engaging with expert knowledge is to evaluate its reliability (Zinn 2009; Wynne 1996; Beierle and Konisky 2000; Beck 1986).

6.4 Implications

The participatory process developed here has linked the goals and processes of integrated and deliberative (Jacobs 1997; Lo and Spash 2013) valuation of ecosystem services to outline how both approaches can be produced in parallel. Although cross-sectional studies highlight the diversity of rationales within and between these two valuation approaches (Raymond et al. 2014; Lienhoop et al. 2015; Carnoye and Lopes 2015), both schools of valuation reframe valuation as an institution through which values are constructed (Niemeyer and Spash 2001). Furthermore, emerging developments in deliberative valuation to address the external critique of monetary valuation (Jacobs 1997; Lo and Spash 2013; Vatn 2004) share the concerns of the integrated valuation school over the exclusion of non-utilitarian (Lo and Spash 2013) and incommensurable values (Vatn 2004). Despite these mutual starting points, the fields of deliberative valuation (Kenter et al. 2016b) and integrated valuation (Jacobs et al. 2016) have recently evolved separately. Although the focus of this thesis in terms of deliberative valuation has been more focused on the internal critique of monetary valuation (Álvarez-Farizo and Hanley 2006; MacMillan et al. 2002; Niemeyer and Spash 2001), the valuation outcomes provisionally suggest that there are synergies in adopting a 'deliberative-integrated' valuation approach, with implications for adaptation governance: whereas quantitative spatial patterns of socio-cultural value support the allocation of existing resources (4.4.3), qualitative knowledge highlight the past and current processes that form the basis for the pattern of socio-cultural value (4.3.4). This synergy of plural valuation framings producing deliberation on many types of knowledge potentially has implications for adaptation, as

plurality of knowledge types has been observed to foster polycentric modes of governance (Berkes 2004). Given that the goals of both valuation approaches are aligned to support methodological development for citizen engagement in adaptation (3.1 and 5.1), further research should attempt to explore how trade-offs between the goals for each approach can be minimised. For example, here the elicitation and measurement of socio-cultural values was prioritised (4.2.4), limiting the formulation of social and shared values and priorities (Irvine et al. 2016).

Scholars (Brink and Wamsler 2018; Ford et al. 2011) have observed even forerunners of adaptation to predominantly not engage citizens, with negligible attention being paid towards vulnerable groups. Against the notable attention that the governance consequences of unrepresentative or skewed engagement have received in environmental and adaptation literature (Mees et al. 2014; Few et al. 2008; Glavovic et al. 2016), the participatory process here provides practical ideas of what is required to engage citizens across the demographic spectrum. These include a high-effort recruitment technique of face-to-face engagement to reduce selection bias, and a participation fee to attract citizens who were not motivated to attend otherwise (5.5.1). Whereas some participants justified their participation by comparing the fee to their daily wage, others were interested in the opportunity to learn about their area. Some described the workshops as an interesting and unique way to spend a Saturday, and for others, it was a chance to share their views on the local planning. As a result, citizens were engaged even from the most deprived areas (Appendix D), which is often difficult (Ferragina et al. 2013).

6.5 Thesis conclusion

As sea levels rise, stakeholders need to work together more closely on local shorelines, like the Inner Forth in Scotland. In low-lying areas, adaptation to rising sea levels may require the nature-based solution of intentionally realigning shorelines landwards to restore salt marshes and mudflats. This thesis has examined the governance context and methodological issues of citizen engagement in local-scale adaptation, with a focus on the

application of participatory valuation methods. The novelty of this thesis is based on the extensive and deliberative engagement of citizens through multiple stages to develop a valuation approach that combines both a choice experiment and socio-cultural valuation methods.

First, this thesis contributes to the adaptation literature (Kochnower et al. 2015; Abel et al. 2011; McFadden 2010; Bisaro and Hinkel 2016; Anguelovski and Carmin 2011) by identifying how both the informal governance structures (social norms and attitudes) and the material consequences influence the local adaptation dilemmas in the Inner Forth. Whereas citizens living on the shores of the Inner Forth would appreciate the socio-cultural and wildlife benefits provided by nature-based shoreline defences, these would come at a cost for the livelihoods and agricultural heritage of the current landowners. In line with evidence on the increasing popularity of polycentric adaptation governance modes in the UK and elsewhere in Europe (Penning-Rowsell and Johnson 2015; Mees et al. 2016; Ford et al. 2011; Newig and Fritsch 2009; Huitema et al. 2016), I find the spectrum of stakeholders engaged in adaptation to be widening, although emerging shoreline partnerships, which are the main vehicles of polycentrism, are limited to short-term funding, as part of a systemic national funding gap (Porter et al. 2015). This spectrum, however, does not yet include (representative groups of) citizens, private sector and landowners, with several implications for adaptation in light of the governance theories on participation and adaptation. Exclusion of citizens potentially limits the legitimacy of decision-making processes (Mees et al. 2014; Stern and Fineberg 1996), and, assuming their attitudes would shape decision-making outcomes (Newig and Fritsch 2009), the public acceptance of adaptation measures. Furthermore, their inclusion potentially reinforces the negative effects of the current (un)awareness of climate risks by reducing citizens' motivation to engage (Abel et al. 2011). Inclusion of citizens would potentially help to build trust (Jones et al. 2015) and consensus (e.g. Akompab et al. 2016), and, as the empirical material presented here shows, support the uptake of nature-based adaptation and bring other-regarding moral principles and biocentric values into decision-making. Finally, inclusion of farmers would also help to overcome existing norms that currently work against nature-based coastal adaptation. Such conflicting norms were

identified even amongst locally active organisations whose attitudes are primarily positive towards nature-based adaptation.

Second, this thesis has illustrated the importance of value framings in determining the outcomes of citizen engagement using four value concepts (space, use, ethical position and expression) in resonance with recent developments in participatory theory (Reed et al. 2017; Brooks et al. 2013) and the school of integrated valuation (Jacobs et al. 2018; Pascual et al. 2017). Quantitative, use-based and spatially explicit values, which emphasise economic world views, provide the pattern of demand for ecosystem services. Qualitative, deliberated and anthropocentric values, which best reflect socio-cultural world views, provide a better understanding of the social processes leading to the demand for ecosystem services. Finally, the biocentric orientations of value (unsurprisingly), together with non-use values, best reflect the ecological world views. By bridging and contributing to the intersection of participatory enquiry and integrated valuation, these findings challenge researchers to consider whether their standardised methods for valuation, such as participatory GIS, choice experiments or other ecosystem services tools, may be too narrow in their framing and process, to the extent that the intended participants who hold incompatible world views are excluded.

Third, in the context of the Inner Forth where citizens living on its shores hold little knowledge about local climate risks, this thesis contributes to sparse literature on methodological insights to building citizens' capacity to engage in adaptation (Petts 2007; Koontz 2013). By showing how the deliberative approach developed here, which explicitly considers knowledge gaps and different knowledge types, considerably shapes and improves the valuation outcomes (emergence of clearer priorities, improved model fit and participant confidence), this thesis provides quantitative evidence to support the broader premise that deliberation builds citizens' ability to engage in adaptation governance (Abel et al. 2011; Hobson and Niemeyer 2011; Mees et al. 2014; Glavovic et al. 2016; Tippet et al. 2005; Lebel et al. 2016). Here local knowledge building is identified to be particularly important in building the confidence of participants and by complementing topics covered by experts. This underscores the calls for future research

to develop deliberative methods to integrate different knowledge types (Raymond et al. 2010; Huntington et al. 2002; Olsson and Folke 2001; Reed 2008; Hofmeester et al. 2012). Finally, by showing how deliberative interventions increase resistance to maintaining the status quo shoreline amongst the participants, this thesis introduces provisional evidence of how deliberative valuation approaches not only improve the quality of participation and analysis, but also shape and build citizens' attitudes towards adaptation.

REFERENCES

Abel N, Gorddard R, Harman B, Leitch A, Langridge J, Ryan A, Heyenga S (2011) Sea level rise, coastal development and planned retreat: analytical framework, governance principles and an Australian case study. Environ. Sci. Policy 14:279–288. doi: 10.1016/j.envsci.2010.12.002

Adam P (2002) Saltmarshes in a time of change. Environ. Conserv 29: 39-61. doi: 10.1017/S0376892902000048

Adaptation Scotland (2016) Adaptation Scotland Interim impact report. Sniffer. http://adaptationscotland.org/application/files/5514/7738/6062/AS_Impact_Report_2015-2016_Final_for_printing.pdf. Accessed 23 January 2018

Agardy T, Alder J, Dayton P, Curran S, Kitchingman A, Wilson M, Catenazzi (2005) Coastal Systems. In: Millennium Ecosystem Assessment. Ecosystems and Human Well-being: Current State and Trends Assessment. World Resources Institute, Washington DC, 37 pp

Ainscough J, Wilson M, Kenter JO (2018) Ecosystem services as a post-normal field of science. Ecosyst. Serv 31:93–101. doi: 10.1016/j.ecoser.2018.03.021

Ajzen I, Joyce N, Sheikh S, Cote NG (2011) Knowledge and the Prediction of Behavior: The Role of Information Accuracy in the Theory of Planned Behavior. Basic Appl. Soc. Psych 33:101–117. doi: 10.1080/01973533.2011.568834

Akompab DA, Bi P, Williams S, Saniotis A, Walker I, Augoustinos M (2013) Engaging stakeholders in an adaptation process: governance and institutional arrangements in heat-health policy development in Adelaide, Australia. Mitig. Adapt. Strateg. Glob. Change 18:1001–1018. doi: 10.1007/s11027-012-9404-4

Alessa L (Na'ia), Kliskey A (Anaru), Williams P, Barton M (2008) Perception of change in freshwater in remote resource-dependent Arctic communities. Glob. Environ. Change 18:153–164. doi: 10.1016/j.gloenvcha.2007.05.007

Álvarez-Farizo B, Hanley N (2006) Improving the process of valuing non-market benefits: combining citizens' juries with choice modelling. Land Econ 82:465–478. doi: 10.3368/le.82.3.465

Álvarez-Farizo B, Hanley N, Barberán R, Lázaro A (2007) Choice modeling at the "market stall": Individual versus collective interest in environmental valuation. Ecol. Econ 60:743–751. 10.1016/j.ecolecon.2006.01.009

Ambros P (2016) Bridging to the common ground, adapting to climate change through sustainable estuarine land use: a study of the Inner Forth, Scotland. Master Thesis Lund University Centre for Sustainability Science

Anguelovski I, Carmin J (2011) Something borrowed, everything new: innovation and institutionalization in urban climate governance. Curr. Opin. Env. Sust 3:169–175. doi: 10.1016/j.cosust.2010.12.017

Ansell C, Gash A (2008) Collaborative Governance in Theory and Practice. J. Public. Adm. Res. Theory 18:543–571. doi: 10.1093/jopart/mum032

Anthony AJ, Atwood P, August P, Byron C, Cobb S, Foster C, Fry C, Gold A, Hagos K, Heffner L, Kellogg DQ, Lellis-Dibble K, Opaluch JJ, Oviatt C, Pfeiffer-Herbert A, Rohr N, Smith L, Smythe T, Swift J, Vinhateiro N (2009) Coastal Lagoons and Climate

Change: Ecological and Social Ramifications in the U.S. Atlantic and Gulf Coast Ecosystems. Ecol. Soc 14:8. doi: 10.5751/es-02719-140108

Aradóttir Á, Petursdottir T, Halldorsson G, Svavarsdóttir K, Arnalds O (2013) Drivers of Ecological Restoration: Lessons from a Century of Restoration in Iceland. Ecol. Soc 18: 33. doi: 10.5751/ES-05946-180433

Archie KM, Dilling L, Milford JB, Pampel FC (2014) Unpacking the "information barrier": Comparing perspectives on information as a barrier to climate change adaptation in the interior mountain West. J. Environ. Manage 133:397–410. doi: 10.1016/j.jenvman.2013.12.015

Aronson J, Clewell AF, Blignaut JN, Milton SJ (2006) Ecological restoration: A new frontier for nature conservation and economics. J. Nat. Conserv 14:135–139. doi: 10.1016/j.jnc.2006.05.005

Aylett A (2010) Conflict, Collaboration and Climate Change: Participatory Democracy and Urban Environmental Struggles in Durban, South Africa. Int. J. Urban Reg. Res 34:478–495. doi: 10.1111/j.1468-2427.2010.00964.x

Babbie ER (2013) The practice of social research. Wadsworth Cengage Learning, Belmont, California, 592 pp

Bardi A, Schwartz SH (2003) Values and behavior: strength and structure of relations. Pers. Soc. Psychol. Bull 29:1207–1220. doi: 10.1177/0146167203254602

Barker T, Scrieciu Ş, Taylor D (2008) Climate Change, Social Justice and Development. Dev. 51:317–324. doi: 10.1057/dev.2008.33

Beck U (1992) Risk society: towards a new modernity (Translated by Ritter M) Sage Publications, London (Original work published 1986), 266 pp

Bekker-Grob EW, Donkers B, Jonker MF, Stolk EA (2015) Sample Size Requirements for Discrete-Choice Experiments in Healthcare: a Practical Guide. Pat 8:373–384. doi: 10.1007/s40271-015-0118-z

Bergstrom JC, Stoll JR, Randall A (1990) The Impact of Information on Environmental Commodity Valuation Decisions. Am. J. Agr. Econ 72:614–621. doi: 10.2307/1243031

Berkes F (2004) Rethinking Community-Based Conservation. Conserv. Biol 18:621–630. doi: 10.1111/j.1523-1739.2004.00077.x

Bisaro A, Hinkel J (2016) Governance of social dilemmas in climate change adaptation. Nat. Clim. Chang. 6:354–359. doi: 10.1038/nclimate2936

Bisaro A, Roggero M, Villamayor-Tomas S (2018) Institutional Analysis in Climate Change Adaptation Research: A Systematic Literature Review. Ecol. Econ 151:34–43. doi: 10.1016/j.ecolecon.2018.04.016

Boardman AE (2006) Cost-benefit analysis: concepts and practice. Pearson/Prentice Hall, Upper Saddle River, New Jersey, 576 pp

Boeraeve F, Dendoncker N, Jacobs S, Gómez-Baggethun E, Dufrêne M (2015) How (not) to perform ecosystem service valuations: pricing gorillas in the mist. Biodivers. Conserv 24:187–197. doi: 10.1007/s10531-014-0796-1

Bouma JA, Beukering PJH van (2015) Ecosystem Services: From Concept to Practice. Cambridge University Press, Cambridge, 278 pp

Bourke B (2014) Positionality: Reflecting on the Research Process. Qual. Rep. 19:1–9

Boyer-Villemaire U, Bernatchez P, Benavente J, Cooper JAG (2014) Quantifying community's functional awareness of coastal changes and hazards from citizen

perception analysis in Canada, UK and Spain. Ocean Coast. Managex 93:106–120. doi: 10.1016/j.ocecoaman.2014.03.016

Boyes SJ, Elliott M (2014) Marine legislation – The ultimate 'horrendogram': International law, European directives & national implementation. Marine Poll. Bull 86:39-47. doi: 10.1016/j.marpolbul.2014.06.055

Boyes SJ, Elliott M (2015) The excessive complexity of national marine governance systems – Has this decreased in England since the introduction of the Marine and Coastal Access Act 2009? Mar. Policy 51:57-65. doi: 10.1016/j.marpol.2014.07.019

Brady AF, Boda CS (2017) How do we know if managed realignment for coastal habitat compensation is successful? Insights from the implementation of the EU Birds and Habitats Directive in England. Ocean Coast. Manage 143:164–174. doi: 10.1016/j.ocecoaman.2016.11.013

Breuste JH (2011) Urban Ecology: Patterns, Processes, and Applications. Oxford University Press, Oxford, 390 pp

Brink E, Aalders T, Ádám D, Feller R, Henselek Y, Hoffmann A, Ibe K, Matthey-Doret A, Meyer M, Negrut NL, Rau A, Riewerts B, von Schuckmann L, Törnros S, von Wehrden H, Abson DJ, Wamsler C (2016) Cascades of green: A review of ecosystem-based adaptation in urban areas. Glob. Environ. Chang 36: 111–123. doi: 10.1016/j.gloenvcha.2015.11.003.

Brink E, Wamsler C (2018) Collaborative Governance for Climate Change Adaptation: Mapping citizen–municipality interactions. Environ. Policy Governance 28:82–97. doi: 10.1002/eet.1795

Brooks J, Waylen KA, Mulder MB (2013) Assessing community-based conservation projects: A systematic review and multilevel analysis of attitudinal, behavioral, ecological, and economic outcomes. Environ. Evid 2:2. doi: 10.1186/2047-2382-2-2

Brown G (2004) Mapping Spatial Attributes in Survey Research for Natural Resource Management: Methods and Applications. Soc. Nat. Resourc 18:17–39. doi: 10.1080/08941920590881853

Brown G, Raymond C (2007) The relationship between place attachment and landscape values: Toward mapping place attachment. Appl. Geogr 27:89–111. doi: 10.1016/j.apgeog.2006.11.002

Brown G, Donovan S (2014) Measuring Change in Place Values for Environmental and Natural Resource Planning Using Public Participation GIS (PPGIS): Results and Challenges for Longitudinal Research. Soc. Nat. Resourc 27:36–54. doi: 10.1080/08941920.2013.840023

Bullock CH, Kay J (1997) Preservation and Change in the Upland Landscape: The Public Benefits of Grazing Management. J. Environ. Plan. Manag 40:315–334. doi: 10.1080/09640569712119

Bundy A, Chuenpagdee R, Cooley S, Glaeser B, McManus LT (2016) Global change, ensuing vulnerabilities, and social responses in marine environments. Reg. Envir. Change 16:273–276. doi: 10.1007/s10113-015-0906-y

Burkhard B, Kroll F, Nedkov S, Mueller F (2012) Mapping ecosystem service supply, demand and budgets. Ecol Indic 21:17–29. doi: 10.1016/j.ecolind.2011.06.019

Butchart S, Dieme-Amting E, Gitay H, Raaymakers S, Taylor D (2005) Ecosystems and Human Well-being: Wetlands and Water Synthesis. In: Millennium Ecosystem Assessment. World Resources Institute, Washington DC, 80 pp

Cairney P (2016) The Politics of Evidence-Based Policy Making. Palgrave Pivot, London, 137 pp

Carlsson F, Mørkbak MR, Olsen SB (2012) The first time is the hardest: A test of ordering effects in choice experiments. J. Choice Model 5:19–37. doi: 10.1016/S1755-5345(13)70051-4Carmin J, Anguelovski I, Roberts D (2012) Urban Climate Adaptation in the Global South: Planning in an Emerging Policy Domain. J. Plan. Educ. Res 32:18–32. doi: 10.1177/0739456X11430951

Cent J, Mertens C, Niedziałkowski K (2013) Roles and impacts of non-governmental organizations in Natura 2000 implementation in Hungary and Poland. Environ Conserv 40: 119-128. doi: 10.1017/S0376892912000380

Chan KMA, Satterfield T, Goldstein J (2012) Rethinking ecosystem services to better address and navigate cultural values. Ecol. Econ 74:8–18. doi: 10.1016/j.ecolecon.2011.11.011

Cheng AS, Randall-Parker T (2017) Examining the Influence of Positionality in Evaluating Collaborative Progress in Natural Resource Management: Reflections of an Academic and a Practitioner. Soc. Nat. Resour. 30:1168–1178. doi: 10.1080/08941920.2017.1295493

Chmura GL, Anisfeld SC, Cahoon DR, and Lynch JC (2003) Global carbon sequestration in tidal, saline wetland soils, Glob Biogeochem. Cycles 17. doi:10.1029/2002GB001917,

Christie M, Hanley N, Warren J, Murphy K, Wright R, Hyde T (2006) Valuing the diversity of biodiversity. Ecol. Econ 58:304–317. doi: 10.1016/j.ecolecon.2005.07.034

Christie M, Rayment M (2012) An economic assessment of the ecosystem service benefits derived from the SSSI biodiversity conservation policy in England and Wales. Ecosyst. Serv 1:70–84. doi: 10.1016/j.ecoser.2012.07.004

Church A, Burgess J, Ravenscroft N (2011) Chapter 16 Cultural Services. In: The UK National Ecosystem Assessment Technical Report. UK National Ecosystem Assessment. UNEP-WCMC, Cambridge, 60 pp

City of Edinburgh Council (2016) Local Flood Risk Management Plan. http://www.edinburgh.gov.uk/downloads/file/7455/draft_local_flood_risk_management_plan. Accessed 23 January 2018

Clewell AF, Aronson J (2006) Motivations for the Restoration of Ecosystems. Cons. Biol 20:420–428. doi: 10.1111/j.1523-1739.2006.00340.x

ClimateXChange (2016) Flooding and Infrastructure. ClimateXChange Secretariat. http://www.climatexchange.org.uk/adapting-to-climate-change/indicators-and-trends/flooding-and-infrastructure. Accessed 16 June 2017

Colclough S, Fonseca L, Astley T, Thomas K, Watts W (2005) Fish utilisation of managed realignments. Fisher. Manag. Ecol. 12:351-60. doi: 10.1111/j.1365-2400.2005.00467.x

Colding J, Barthel S, Bendt P, Snep R, van der Knaap W, Ernstson H. (2013) Urban green commons: Insights on urban common property systems. Glob. Environ. Change 23:1039–1051. doi: 10.1016/j.gloenvcha.2013.05.006

Cooper N, Brady E, Steen H, Bryce R (2016) Aesthetic and spiritual values of ecosystems: Recognising the ontological and axiological plurality of cultural ecosystem "services." Ecosyst. Serv. 21:218–229. doi: 10.1016/j.ecoser.2016.07.014

Creswell JW, Plano Clark VL (2007) Designing and conducting mixed methods research. SAGE Publications, London, 275 pp

Curado G, Manzano-Arrondo V, Figueroa E, Castillo JM (2014) Public Perceptions and Uses of Natural and Restored Salt Marshes. Landsc. Res 39:668–679. doi: 10.1080/01426397.2013.772960

Czembrowski P, Kronenberg J, Czepkiewicz M (2016) Integrating non-monetary and monetary valuation methods – SoftGIS and hedonic pricing. Ecol. Econ 130:166–175. doi: 10.1016/j.ecolecon.2016.07.004

Daily GC, Söderqvist T, Aniyar S, Arrow K, Dasgupta P, Ehrlich PR, Folke C, Jansson A, Jansson BO, Kautsky N, Levin S (2000) The Value of Nature and the Nature of Value. Sci 289:395–396. doi: 10.1126/science.289.5478.395

Daily GC, Polasky S, Goldstein J, Kareiva PM, Mooney HA, Pejchar L, Ricketts TH, Salzman J, Shallenberger R (2009) Ecosystem services in decision making: time to deliver. Front. Ecol. Environ 7:21–28. doi: 10.1890/080025

Davidson MD (2013) On the relation between ecosystem services, intrinsic value, existence value and economic valuation. Ecol. Econ 95:171–177. Doi: 10.1016/j.ecolecon.2013.09.002

Dendoncker N, Keene K, Jacobs S, Gómez-Baggethun E (2013) Inclusive Ecosystem Services Valuation. In: Jacobs S, Dendoncker N and Keene H (eds) Ecosystem Services: Global Issues, Local Practices. Elsevier, San Diego and Waltham, pp 3-12

Díaz S, Demissew S, Carabias J, Joly C, Lonsdale M, Ash N, Larigauderie A, Adhikari JR, Arico S, Báldi A, Bartuska A (2015) The IPBES Conceptual Framework — connecting nature and people. Curr. Opin. Env. Sust 14:1–16. doi: 10.1016/j.cosust.2014.11.002

Dietz T, Stern PC, Dan A (2009) How Deliberation Affects Stated Willingness to Pay for Mitigation of Carbon Dioxide Emissions: An Experiment. Land Econ 85:329–347.doi: 10.3368/le.85.2.329

Dodman D, Mitlin D (2013) Challenges for Community-Based Adaptation: Discovering the Potential for Transformation. J Int. Dev 25:640–659. doi: 10.1002/jid.1772

Doody JP (2004) 'Coastal Squeeze': An Historical Perspective. J Coast. Cons 10:129-138. doi: 10.1007/bf02818949

Doody JP (2013) Coastal squeeze and managed realignment in southeast England, does it tell us anything about the future? Ocean Coast. Manag 79:34-41. doi: 10.1016/j.ocecoaman.2012.05.008

Driessen P, Hegger D, Bakker M, van Rijswick HFMW; Kundzewicz ZW (2016) Toward more resilient flood risk governance. Ecol. Soc 21:53. doi: 10.5751/ES-08921-210453

Dumaru P (2010) Community-based adaptation: enhancing community adaptive capacity in Druadrua Island, Fiji. Wiley Interdiscip. Rev. Clim. Chang 1:751–763. doi: 10.1002/wcc.65

Durham E, Baker H, Smith M, Moore E, Morgan V (2014) The BiodivERsA Stakeholder Engagement Handbook. BiodivERsA, Paris, 108 pp

Ensor J, Berger R (2009) Community-based adaptation and culture in theory and practice. In: Adger W, Lorenzoni I, O'Brien K (eds.). Adapting to Climate Change: Thresholds, Values, Governance. Cambridge, Cambridge University Press, pp 227-239

Escobar O (2017) Pluralism and Democratic Participation: What Kind of Citizen are Citizens Invited to be? Contemp. Pragmat 14:416–438. doi: 10.1163/18758185-01404002

Esteves LS, Thomas K (2014) Managed realignment in practice in the UK: results from two independent surveys. J Coast. Res 407–413. doi: 10.2112/SI70-069.1

European Commission (2013) Share of population in coastal regions living within 50km from the coastline by NUTS3 regions. Eurostat. http://ec.europa.eu/eurostat/statistics-

explained/index.php/File:Share_of_population_in_coastal_regions_living_within_50km_from_the_coastline_by_NUTS3_regions.png#filehistory. Accessed 16 June 2017

Falk-Andersson J, Foley NS, Armstrong CW, van den Hove S, van Rensburg TM, Tinch R (2015) A deliberative approach to valuation and precautionary management of cold water corals in Norway. Marit. Stud 14:7. doi: 10.1186/s40152-015-0023-z

Fals-Borda O, Rahman MA (1991) Action and knowledge, breaking the monopoly with participatory action research. Apex Press, New York, 190 pp

Fanny B, Nicolas D, Sander J, Erik GB, Marc D (2015) How (not) to perform ecosystem service valuations: pricing gorillas in the mist. Biodivers. Conserv 24:187–197. doi: 10.1007/s10531-014-0796-1

Fazey I, Fazey JA, Salisbury JG, Lindenmayer DB, Dovers S (2006) The nature and role of experiential knowledge for environmental conservation. Environ. Conserv 33:1–10. doi: 10.1017/S037689290600275X

Fazey I, Salisbury JG, Lindenmayer DB, Maindonald J, Douglas R (2004) Can methods applied in medicine be used to summarize and disseminate conservation research? Environ. Conserv 31:190–198. doi: 10.1017/S0376892904001560

Fazey I, Schäpke N, Caniglia G, Patterson J, Hultman J, Van Mierlo B, Säwe F, Wiek A, Wittmayer J, Aldunce P, Al Waer H, Battacharya N, Bradbury H, Carmen E, Colvin J, Cvitanovic C, D'souza M, Gopel M, Goldstein B, Hämäläinen T, Harper G, Henfry T, Hodgson A, Howden MS, Kerr A, Klaes M, Lyon C, Midgley G, Moser S, Mukherjee N, Müller K, O'brien K, O'Connell DA, Olsson P, Page G, Reed MS, Searle B, Silvestri G, Spaiser V, Strasser T, Tschakert P, Uribe-Calvo N, Waddell S, Rao-Williams J, Wise R, Wolstenholme R, Woods M, Wyborn C (2018) Ten essentials for action-oriented and second order energy transitions, transformations and climate change research. Energy Res. Soc. Sci 40:54–70. doi: 10.1016/j.erss.2017.11.026

Ferragina E, Tomlinson M, Walker R (2013) Poverty, participation and choice. Joseph Rowntree Foundation. https://www.jrf.org.uk/report/poverty-participation-and-choice. Accessed 4 July 2017

Few R, Brown K, Tompkins EL (2007) Public participation and climate change adaptation: avoiding the illusion of inclusion. Clim. Policy 7:46–59. doi: 10.1080/14693062.2007.9685637

Finlay L (2002) "Outing" the researcher: the provenance, process, and practice of reflexivity. Qual. Health Res 12:531–545. doi: 10.1177/104973202129120052

Fischhoff B (2000) Informed Consent for Eliciting Environmental Values. Environ. Sci. Technol 34:1439–1444. doi: 10.1021/es990726z

Fish R, Saratsi E (2015) Using Ecosystem Services in Public Engagement and Dialogue on the Natural Environment. Living With Environmental Change. http://www.nerc.ac.uk/research/partnerships/ride/lwec/ppn/ppn23/. Accessed 18 August 2017

Fishkin JS (2003) Consulting the public through deliberative polling. J Pol Anal Manag 22:128–133. doi: 10.1002/pam.10101

Folke C (2004) Traditional Knowledge in Social–Ecological Systems. Ecol. Soc 9:7. doi: 10.5751/ES-01237-090307

Ford J, Berrang-Ford L, Paterson J (2011) A systematic review of observed climate change adaptation in developed nations. Clim. Chang 106:327–336. doi: 10.1007/s10584-011-0045-5

Foster NM, Hudson MD, Bray S, Nicholls RJ (2013) Intertidal mudflat and saltmarsh conservation and sustainable use in the UK: A review. J Environ. Manag 126:96–104. doi: 10.1016/j.jenvman.2013.04.015

French P (1997) Coastal and estuarine management. Routledge, London, 251 pp

Given LM (2008) The SAGE Encyclopedia of Qualitative Research Methods. SAGE Publications, London, 1014 pp

Glaves P, O'Connor M (2010) Valuing Ecosystem Services: Applications, Concerns and Perceptions of Ecologists and Environmental Managers. In Practice. https://www.cieem.net/2013-spring-conference Accessed 18 August 2017

Glavovic BC (2016) Towards deliberative coastal governance: insights from South Africa and the Mississippi Delta. Reg Environ. Chang 16:353–365. doi: 10.1007/s10113-014-0727-4

Goldman RL, Tallis H, Kareiva P, Daily GC (2008) Field evidence that ecosystem service projects support biodiversity and diversify options. Proc. Nat. Acad. Sci 105:9445–9448. doi: 10.1073/pnas.0800208105

Gomm R (2008) Social research methodology a critical introduction. Palgrave Macmillan, Basingstoke, 428 pp

Gómez-Baggethun E, Barton DN (2013) Classifying and valuing ecosystem services for urban planning. Ecol. Econ 86:235–245. doi: 10.1016/j.ecolecon.2012.08.019

Gómez-Baggethun E, Martín-López B (2014) State-of-the-art report on integrated valuation of ecosystem services. European Commission. http://www.openness-project.eu/sites/default/files/Deliverable%204%201_Integrated-Valuation-Of-Ecosystem-Services.pdf. Accessed 18 August 2017

Granderson AA (2014) Making sense of climate change risks and responses at the community level: A cultural-political lens. Clim. Risk Manag 3:55–64. doi: 10.1016/j.crm.2014.05.003

Gregory R, Slovic P (1997) A constructive approach to environmental valuation. Ecol. Econ 21:175–181. doi: 10.1016/S0921-8009(96)00104-8

Groot RS, Alkemade R, Braat L, Hein L, Willemen LC (2010) Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol. Complex 7:260–272. doi: 10.1016/j.ecocom.2009.10.006

Guillemin M, Gillam L (2004) Ethics, Reflexivity, and "Ethically Important Moments" in Research. Qual. Inq 10:261–280. doi: 10.1177/1077800403262360

Curado G, Manzano-Arrondo V, Figueroa E, Castillo JM (2014) Public Perceptions and Uses of Natural and Restored Salt Marshes. Lands. Res. 39:668–679. doi: 10.1080/01426397.2013.772960

Haase D, Frantzeskaki N, Elmqvist T (2014) Ecosystem Services in Urban Landscapes: Practical Applications and Governance Implications. AMBIO 43:407–412. doi: 10.1007/s13280-014-0503-1

Habermas, J (1987) Theory of Communicative Action, Volume Two: Lifeworld and System: A Critique of Functionalist Reason (Translated by Thomas A) Polity Press, Cambridge (Original work published 1981), 457 pp

Hanley N, Wright RE, Adamowicz V (1998) Using Choice Experiments to Value the Environment. Environ Resourc. Econ 11:413–428. doi: 10.1023/A:1008287310583

Hansen M, Ramasar V, Buchanan K (2014) Localising global environmental governance norms: Implications for justice. In: Sowman M, Wynberg R (eds) Governance for

Justice and Environmental Sustainability: Lessons across Natural Resource Sectors in Sub-Saharan Africa. Routledge. pp 43–62

Hansom JD, Lees RG, Maslen J, Tilbrook C, McManus J (2001) Coastal dynamics and sustainable management: the potential for managed realignment in the Forth estuary. In: Gordon JE, Lees KF (eds) Earth Science and the Natural Heritage. The Stationary Office, Edinburgh. pp 148–160

Hattam C, Böhnke-Henrichs A, Börger T, Burdon D, Hadjimichael M, Delaney A, Atkins JP, Garrard S, Austen MC. (2015) Integrating methods for ecosystem service assessment and valuation: Mixed methods or mixed messages? Ecol. Econ 120:126–138. doi: 10.1016/j.ecolecon.2015.10.011

Healey P (2006) Transforming governance: Challenges of institutional adaptation and a new politics of space. Eur. Plan. Stud 14:299–320. doi: 10.1080/09654310500420792

Hensher DA, JM Rose, WH Greene (2005) Applied Choice Analysis: A Primer. Cambridge University Press, Cambridge, 744 pp

Heritage Lottery Fund (2017) Landscape Partnerships. The National Lottery. https://www.hlf.org.uk/looking-funding/our-grant-programmes/landscape-partnerships. Accessed 19 August 2017

Higuera D, Martín-López B, Sánchez-Jabba A (2013) Social preferences towards ecosystem services provided by cloud forests in the neotropics: implications for conservation strategies. Reg. Environ. Change 13:861–872. doi: 10.1007/s10113-012-0379-1

Hobson K, Niemeyer S (2011) Public responses to climate change: The role of deliberation in building capacity for adaptive action. Glob. Environ. Change 21:957–971. doi: 10.1016/j.gloenvcha.2011.05.001

Hofmeester C, Bishop B, Stocker L, Syme G (2012) Social cultural influences on current and future coastal governance. Futures 44:719–729. doi: 10.1016/j.futures.2012.04.002

Holland A (2002) Are choice trade-offs? In: Bromley D, Paavola J (eds) Economics, Ethics, and Environmental Policy: Contested Choices. Blackwell Publishers, pp 17-43

Howarth RB, Wilson MA (2006) A Theoretical Approach to Deliberative Valuation: Aggregation by Mutual Consent. Land Econ 82:1–16. doi: 10.2307/27647687

Huitema D, Adger WN, Berkhout F, Massey EE, Mazmanian D, Munaretto S, Plummer R, Termeer CCJAM (2016) The governance of adaptation: choices, reasons, and effects. Introduction to the Special Feature. Ecol. Soc 21:37. doi: 10.5751/ES-08797-210337

Huntington HP, Brown-Schwalenberg PK, Frost KJ, Fernandez-Gimenez ME, Norton DW, Rosenberg DH (2002) Observations on the Workshop as a Means of Improving Communication Between Holders of Traditional and Scientific Knowledge. Environ. Manage 30:0778–0792. doi: 10.1007/s00267-002-2749-9

Hysing E (2013) Representative democracy, empowered experts, and citizen participation: visions of green governing. Environ. Polit 22:955–974. doi: 10.1080/09644016.2013.817760

Harding J (2013) Qualitative data analysis from start to finish. SAGE Publications, London, 224 pp

Iniesta-Arandia I, García-Llorente M, Aguilera PA, Montes C, Martín-López B (2014) Socio-cultural valuation of ecosystem services: uncovering the links between values, drivers of change, and human well-being. Ecol. Econ 108:36–48. doi: 10.1016/j.ecolecon.2014.09.028

Inner Forth Landscape Initiative (2014) Welcome to IFLI. Inner Forth Landscape Iniative. http://www.innerforthlandscape.co.uk. Accessed 13 March 2017

Irvine KN, O'Brien L, Ravenscroft N, Cooper N, Everard M, Fazey I, Reed MS, Kenter JO (2016) Ecosystem services and the idea of shared values. Ecosyst. Serv 21:184–193. doi: 10.1016/j.ecoser.2016.07.001

Itkonen P, Kopperoinen L, Viinikka A, Olazábal E, Heikinheimo V (2015) Case: Mapping green infrastructure and ecosystem services in the Helsinki-Uusimaa Region. In: Towards a sustainable and genuinely green economy. The value and social significance of ecosystem services in Finland. (TEEB for Finland). Synthesis and roadmap. The Finnish Ministry of Environment, Helsinki, pp 46–58

Jacobs M (1997) Environmental valuation, deliberative democracy and public decision-making institutions. In: Foster J (ed) Valuing nature? Ethics, economics and the environment. Routledge, London, pp 211-231

Jacobs S, Dendoncker N, Keune H (2013) Ecosystem Services: Global Issues, Local Practices. Elsevier Science, San Diego, 456 pp

Jacobs S, Dendoncker N, Martín-López B, Barton DN, Gomez-Baggethun E, Boeraeve F, McGrath FL, Vierikko K, Geneletti D, Sevecke KJ, Pipart N (2016) A new valuation school: Integrating diverse values of nature in resource and land use decisions. Ecosyst. Serv 22:213-20. doi: https://doi.org/10.1016/j.ecoser.2016.11.007

Jacobs S, Martín-López B, Barton DN, Dunford R, Harrison PA, Kelemen E, Saarikoski H, Termansen M, García-Llorente M, Gómez-Baggethun E, Kopperoinen L, Luque S, Palomo I, Priess JA, Rusch GM, Tenerelli P, Turkelboom F, Demeyer R, Hauck J, Keune H, Smith R (2018) The means determine the end – Pursuing integrated valuation in practice. Ecosystem Services 29:515–528. doi: 10.1016/j.ecoser.2017.07.011

Jax K, Furman E, Saarikoski H, Barton DN, Delbaere B, Dick J, Duke G, Görg C, Gómez-Baggethun E, Harrison PA, Maes J, Pérez-Soba M, Saarela S-R, Turkelboom F, van Dijk J, Watt AD (2018) Handling a messy world: Lessons learned when trying to make the ecosystem services concept operational. Ecosyst. Serv 29:415–427. doi: 10.1016/j.ecoser.2017.08.001

Johnson CL, Priest SJ (2008) Flood Risk Management in England: A Changing Landscape of Risk Responsibility? Int. J. Water Resour. Dev 24:513–525. doi: 10.1080/07900620801923146

Jones HP, Hole DG, Zavaleta ES (2012) Harnessing nature to help people adapt to climate change. Nat. Clim. Chang 2:504–509. doi: 10.1038/nclimate1463

Jones N, Clark J (2014) Social capital and the public acceptability of climate change adaptation policies: a case study in Romey Marsh, UK. Climat. Change 123:133–145. doi: 10.1007/s10584-013-1049-0

Jones N, Clark JRA, Malesios C (2015) Social capital and willingness-to-pay for coastal defences in south-east England. Ecol. Econ 119:74–82. doi: 10.1016/j.ecolecon.2015.07.023

Juhola S, Westerhoff L (2011) Challenges of adaptation to climate change across multiple scales: a case study of network governance in two European countries. Environ. Sci. Policy 14: 239–247. doi: 10.1016/j.envsci.2010.12.006

Kelemen E, García-Llorente M, Pataki G, Martín-López B, Gómez-Baggethun E (2014) Non-monetary techniques for the valuation of cosystem service. In: Potschin-Young M, Jax K (eds) OpenNESS Reference Book, 5 pp

Kelemen E (2016) Narrative assessment of ecosystem services. Oppla. http://www.oppla.eu/product/2001. Accessed 18 August 2017

Kenter JO (2014) Valuing the Inner Forth. Final report for the Inner Forth Landscape Initiative. http://innerforthlandscape.co.uk/files/KenterValuingtheInnerForth.pdf Accessed 28 January 2018

Kenter JO (2016a) Integrating deliberative monetary valuation, systems modelling and participatory mapping to assess shared values of ecosystem services. Ecosyst. Serv 21:291-307. doi: 10.1016/j.ecoser.2016.06.010

Kenter JO (2016b) Editorial: Shared, plural and cultural values. Ecosyst. Serv 21:175-183. doi: 10.1016/j.ecoser.2016.10.010

Kenter JO, Hyde T, Christie M, Fazey I (2011) The importance of deliberation in valuing ecosystem services in developing countries — Evidence from the Solomon Islands. Glob Environ. Change 21:505–521. doi: 10.1016/j.gloenvcha.2011.01.001

Kenter JO, O'Brien L, Hockley N, Ravenscroft N, Fazey I, Irvine KN, Reed MS, Christie M, Brady E, Bryce R, Church A (2015) What are shared and social values of ecosystems? Ecological Economics 111:86-99. doi: 10.1016/j.ecolecon.2015.01.006

Kenter JO, Jobstvogt N, Watson V, Irvine KN, Christie M, Bryce R (2016a) The impact of information, value-deliberation and group-based decision-making on values for ecosystem services: Integrating deliberative monetary valuation and storytelling. Ecosyst. Serv 21:270–290. doi: 10.1016/j.ecoser.2016.06.006

Kenter JO, Reed MS, Fazey I (2016b) The deliberative value formation model. Ecosystem Serv 31:194-207. doi: 10.1016/j.ecoser.2016.09.015

Kenyon W, Hanley N (2000) Economic and Participatory Approaches to Environmental Evaluation. University of Glasgow. http://www.gla.ac.uk/media/media_22313_en.pdf. Accessed 19 August 2017

Keske CM, Hoag D, McLeod DM, Bastian CT, Lacy MG (2011) Using mixed methods research in environmental economics: the case of conservation easements. Int. J. Mix. Methods Appl. Bus. Policy Res 1:16–28

Kettunen M, ten Brink P, Underwood E and Salomaa A (2014) Policy needs and opportunities for operationalising the concept of ecosystem services. Institute for European Environmental Policy report for FP7 project OPERAs. https://oppla.eu/sites/default/files/uploads/kettunen-et-al-2014-policy-integration-ecosystem-services-eu-assessment-operas-d4-1.pdf. Accessed 23 January 2018

King SE, Lester JN (1995) The value of salt marsh as a sea defence. Marine Pollut. Bull 30:180–189. doi: 10.1016/0025-326X(94)00173-7

Kirchhoff CJ, Carmen Lemos M, Dessai S (2013) Actionable Knowledge for Environmental Decision Making: Broadening the Usability of Climate Science. Annu. Rev. Environ. Resour 38:393–414. doi: 10.1146/annurev-environ-022112-112828

Klain SC, Chan KMA (2012) Navigating coastal values: Participatory mapping of ecosystem services for spatial planning. Ecol. Econ 82:104–113. doi: 10.1016/j.ecolecon.2012.07.008

Klein J, Juhola S, Landauer M (2017) Local authorities and the engagement of private actors in climate change adaptation. Environ. Plan. C Polit. Spac 35:1055–1074. doi: 10.1177/0263774X16680819

Kochnower D, Reddy SMW, Flick RE (2015) Factors influencing local decisions to use habitats to protect coastal communities from hazards. Ocean. Coast. Manage 116:277–290. doi: 10.1016/j.ocecoaman.2015.07.021

Koetse MJ (2017) Effects of payment vehicle non-attendance in choice experiments on value estimates and the WTA–WTP disparity. J Environ. Econ. Policy 6:225–245. doi: 10.1080/21606544.2016.1268979

Koontz TM (2014) Social learning in collaborative watershed planning: the importance of process control and efficacy. J. Environ. Plan. Manage 57:1572–1593. doi: 10.1080/09640568.2013.820658

Kumar S (2002) Methods for community participation: a complete guide for practitioners. Intermediate Technology Development Group, London, 333 pp

Kushner B, Jungwiwattanaporn M, Waite R, Burke L (2012) Influence of coastal economic valuations in the Caribbean: enabling conditions and lessons learned. World Resources Institute. http://bibliotecavirtual.minam.gob.pe/biam/bitstream/handle/minam/1797/BIV01568.pdf?sequence=1&isAllowed=y. Accessed 19 August 2017

Langemeyer J, Baró F, Roebeling P, Gómez-Baggethun E (2015) Contrasting values of cultural ecosystem services in urban areas: the case of park Montjuïc in Barcelona. Ecosyst. Serv 12: 178-186 doi: 10.1016/j.ecoser.2014.11.016

LaRiviere J, Czajkowski M, Hanley N, Aanesen M, Falk-Petersen J, Tinch D (2014) The value of familiarity: Effects of knowledge and objective signals on willingness to pay for a public good. J Environ. Econ. Manag 68:376–389. doi: 10.1016/j.jeem.2014.07.004

Laurans Y, Rankovic A, Billé R, Pirard R, Mermet L (2013) Use of ecosystem services economic valuation for decision making: Questioning a literature blindspot. J Environ. Manag 119:208–219. doi: 10.1016/j.jenvman.2013.01.008

Lebel L, Anderies J, Campbell B (2006) Governance and the Capacity to Manage Resilience in Regional Social-Ecological Systems. Ecol. Soc 11:9. doi: 10.5751/ES-01606-110119

Ledoux L, Cornell S, O'Riordan T, Harvey R, Banyard L (2005) Towards sustainable flood and coastal management: identifying drivers of, and obstacles to, managed realignment. Land Use Policy 22:129–144. doi: 10.1016/j.landusepol.2004.03.001

Lesnikowski AC, Ford JD, Berrang-Ford L, Barrera M, Heymann J (2015) How are we adapting to climate change? A global assessment. Mitig. Adapt. Strateg. Glob. Change 20:277–293. doi: 10.1007/s11027-013-9491-x

Lienhoop N (2005) Valuing wilderness preservation in Iceland using WTP and WTA: an investigation into data collection modes. Dissertation, Helmholtz Centre for Environmental Research UFZ

Lienhoop N, MacMillan DC (2007) Contingent valuation: Comparing participant performance in group-based approaches and personal interviews. Environ. Values 16:209–232. doi: 10.3197/096327107780474500

Lienhoop N, Bartkowski B, Hansjuergens B (2015) Informing biodiversity policy: The role of economic valuation, deliberative institutions and deliberative monetary valuation. Environ. Sci. Policy 54:522–532. doi: 10.1016/j.envsci.2015.01.007

Lienhoop N, Voelker M (2016) Preference Refinement in Deliberative Choice Experiments for Ecosystem Service Valuation. Land Econ 92:555–577. doi: 10.3368/le.92.3.555

Lindhjem H, Navrud S (2011) Are Internet surveys an alternative to face-to-face interviews in contingent valuation? Ecol. Econ 70:1628–1637. doi: 10.1016/j.ecolecon.2011.04.002

Lloyd MG, Peel D, Duck RW (2013) Towards a social–ecological resilience framework for coastal planning. Land Use Policy 30:925–933. doi: 10.1016/j.landusepol.2012.06.012

Lo AY and Spash CL (2013) Deliberative monetary valuation: in search of a democratic and value plural approach to environmental policy. J. Econ. Surv 27: 768-789. doi: 10.1111/j.1467-6419.2011.00718.x

Loomis J (2011) What's to Know About Hypothetical Bias in Stated Preference Valuation Studies? J. Econ Surv 25:363–370. doi: 10.1111/j.1467-6419.2010.00675.x

Louviere JJ, Hensher DA, Swait JD (2000) Stated choice methods: analysis and applications. Cambridge University Press, Cambridge, 402 pp

Lowe JA, Howard TP, Pardaens A, Tinker J, Holt J, Wakelin S, Milne G, Leake J, Wolf J, Horsburgh K, Reeder T, Jenkins G, Ridley J, Dye S, Bradley S (2009) UK Climate Projections science report: Marine and coastal projections. Met Office Hadley Centre. http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87905&. Accessed 19 August 2017

Luisetti T, Turner RK, Bateman IJ, Morse-Jones S, Adams C, Fonseca L (2011) Coastal and marine ecosystem services valuation for policy and management: Managed realignment case studies in England. Ocean Coast. Manag. 54:212–224. doi: 10.1016/j.ocecoaman.2010.11.003

Macalister T (2016) Longannet power station closes ending coal power use in Scotland. The Guardian. https://www.theguardian.com/environment/2016/mar/24/longannet-power-station-closes-coal-power-scotland. Accessed 19 August 2017

MacDonald MA, de Ruyck C, Field RH, Bedford A and Bradbury RB (2017) Benefits of coastal managed realignment for society: Evidence from ecosystem service assessments in two UK regions. Estuar. Coast. Shelf Sci (in press) doi: 10.1016/j.ecss.2017.09.007

MacMillan DC, Philip L, Hanley N, Alvarez-Farizo B (2002) Valuing the non-market benefits of wild goose conservation: a comparison of interview and group based approaches. Ecol. Econ 43:49–59. doi: 10.1016/S0921-8009(02)00182-9

MacMillan D, Hanley N, Lienhoop N (2006) Contingent valuation: Environmental polling or preference engine? Ecol. Econ 60:299–307. doi: 10.1016/j.ecolecon.2005.11.031

Mahajan SL, Daw T (2016) Perceptions of ecosystem services and benefits to human well-being from community-based marine protected areas in Kenya. Mar. Policy 74:108–119. doi: 10.1016/j.marpol.2016.09.005

Malinowski B (1944) A scientific theory of culture and other essays. University of North Carolina Press, Chapel Hill, 228 pp

Mann HB, Whitney DR (1947) On a Test of Whether one of Two Random Variables is Stochastically Larger than the Other. Ann Math Statist 18:50–60. doi: 10.1214/aoms/1177730491

March JG, Olsen JP (1983) The New Institutionalism: Organizational Factors in Political Life. American Political Science Review 78:734–749. doi: 10.2307/1961840

Mason RL, Gunst RF, Hess JL (2003) Statistical Principles in Experimental Design. In: Mason RL, Gunst RF, Hess JL (eds) Statistical Design and Analysis of Experiments: With Applications to Engineering and Science John Wiley & Sons, Inc., Hoboken, pp 107-139

Mauthner NS, Doucet A (2003) Reflexive Accounts and Accounts of Reflexivity in Qualitative Data Analysis. Soc 37:413–431. doi: 10.1177/00380385030373002

McCarthy. Boston, Mass.: Beacon Press. ISBN 0-8070-1401-X.Beierle TC, Konisky DM (2000) Values, Conflict, and Trust in Participatory Environmental Planning. J. Pol. Anal. Manag 19:587–602. doi: 10.2307/3325576

McCrum G, Blackstock K, Matthews K, Rivington M, Miller D, Buchan K (2009) Adapting to climate change in land management: the role of deliberative workshops in enhancing social learning. Environ. Policy Govern 19:413–426. doi: 10.1002/eet.525

McDermott M, Mahanty S, Schreckenberg K (2013) Examining equity: A multidimensional framework for assessing equity in payments for ecosystem services. Environ. Sci. Policy 33:416–427. doi: 10.1016/j.envsci.2012.10.006

McFadden L (2010) Exploring system interactions for building resilience within coastal environments and communities. Environ Haz 9:266–283. https://doi.org/10.3763/ehaz.2010.0056

McGranahan G, Balk D, and Anderson B (2007) The rising tide: Assessing the risks of climate change and human settlements in low elevation coastal zones. Environ. Urban 19:17-37. doi: 10.1177/0956247807076960

Mees HLP, Driessen PPJ, Runhaar HAC (2012) Exploring the Scope of Public and Private Responsibilities for Climate Adaptation. J. Environ. Policy Plan 14, 305–330. https://doi.org/10.1080/1523908X.2012.707407

Mees H, Driessen P, Runhaar H (2014) Legitimate adaptive flood risk governance beyond the dikes: the cases of Hamburg, Helsinki and Rotterdam. Reg. Environ. Chang 14:671–682. doi: 10.1007/s10113-013-0527-2

Mees H, Crabbé A, Alexander M, Kaufmann M, Bruzzone S, Lévy L, Lewandowski J (2016) Coproducing flood risk management through citizen involvement: insights from cross-country comparison in Europe. Ecol. Soc 21:. doi: 10.5751/ES-08500-210307

Mees H, Crabbé A, Driessen PPJ (2017) Conditions for citizen co-production in a resilient, efficient and legitimate flood risk governance arrangement. A tentative framework. J. Environ. Policy Plan 19:827–842. doi: 10.1080/1523908X.2017.1299623

Midgley S, McGlashan DJ (2004) Planning and management of a proposed managed realignment project: Bothkennar, Forth Estuary, Scotland. Marine Policy 28:429-435. doi: 10.1016/j.marpol.2003.10.018

Milfont TL (2012) The Interplay Between Knowledge, Perceived Efficacy, and Concern About Global Warming and Climate Change: A One-Year Longitudinal Study. Risk Anal 32:1003–1020. doi: 10.1111/j.1539-6924.2012.01800.x

Miller TR (2013) Constructing sustainability science: emerging perspectives and research trajectories. Sustain Sci 8:279–293. doi: 10.1007/s11625-012-0180-6

Milligan J, O'Riordan T, Nicholson-Cole SA, Watkinson AR (2009) Nature conservation for future sustainable shorelines: Lessons from seeking to involve the public. Land Use Policy 26:203–213. doi: 10.1016/j.landusepol.2008.01.004

Morelli F, Tryjanowski P, Benedetti Y (2016) Differences between niches of anthropocentric and biocentric conservationists: Wearing old clothes to look modern? J. Nat. Conserv 34:101–106. doi: 10.1016/j.jnc.2016.09.005

Moran EF (2010) Environmental social science: human-environment interactions and sustainability. Wiley-Blackwell, Malden, 215 pp

Morelli F, Tryjanowski P, Benedetti Y (2016) Differences between niches of anthropocentric and biocentric conservationists: Wearing old clothes to look modern? J Nat. Conserv 34:101–106. doi: 10.1016/j.jnc.2016.09.005

Moro G (2012) Citizens in Europe: Civic activism and the community democratic experiment. Springer, New York, 210 pp

Morris, RKA (2013) Managed realignment as a tool for compensatory habitat creation – A re-appraisal. Ocean Coast. Manag 73:82-91. doi: 10.1016/j.ocecoaman.2012.12.013

Moser SC, Ekstrom JA (2010) A framework to diagnose barriers to climate change adaptation. PNAS 107: 22026–22031. doi: 10.1073/pnas.1007887107

Moser SC, Williams SJ, Boesch DF (2012) Wicked challenges at land's end: managing coastal vulnerability under climate change. Annu. Rev. Environ. Resour 37:51–78. doi: 10.1146/annurev-environ-021611-135158

Munro A, Hanley ND (2001) Information, uncertainty, and contingent valuation. In: Bateman IJ, Willis KG (eds) Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU, and Developing Countries. Oxford Scholarship Online. http://www.oxfordscholarship.com.ezproxy.is.ed.ac.uk/view/10.1093/0199248915.001.0001/acprof-9780199248919-chapter-9. Accessed 23 January 2017

Myatt LB, Scrimshaw MD, Lester JN (2003) Public perceptions and attitudes towards an established managed realignment scheme: Orplands, Essex, UK. J. Environ. Manage 68:173–181. doi: 10.1016/S0301-4797(03)00065-3

Myatt-Bell LB, Scrimshaw MD, Lester JN, Potts JS (2002) Public perception of managed realignment: Brancaster West Marsh, North Norfolk, UK. Marine Policy 26:45–57. doi: 10.1016/S0308-597X(01)00033-1

Möller I, Kudella M, Rupprecht F, Spencer T, Paul M, Van Wesenbeeck BK, Wolters G, Jensen K, Bouma TJ, Miranda-Lange M, Schimmels S (2014) Wave attenuation over coastal salt marshes under storm surge conditions. Nat. Geosci 7:727-31. doi: 10.1038/ngeo2251

Nabatchi T, Leighninger M (2015) Public participation for 21st century democracy. John Wiley & Sons, Hoboken, New Jersey, 368 pp

NAFC Marine Centre (2015) Shetland Islands Marine Spatial Plan. The University of Highlands and Islands. https://www.nafc.uhi.ac.uk/research/msp/simsp/simsp. Accessed 19 August 2017

National Records of Scotland (2016) Mid-Year Population Estimates Scotland, Mid-2015 and Corrected Population Estimates for Mid-2012, Mid-2013 and Mid-2014. National Records of Scotland. https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-estimates/mid-year-population-estimates/mid-2015-and-corrected-mid-2012-to-mid-2014. Accessed 19 August 2017

Natural Capital Coalition (2017) Protocol Toolkit. Natural Capital Coalition. http://naturalcapitalcoalition.org/protocol-toolkit. Accessed 26 October 2016

O'Connor M, Faucheux S, Froger G, Funtowicz S, Munda G (1996) Emergent complexity and procedural rationality: Post-normal science for sustainability. In: Costanza R (ed) Getting Down to Earth: Practical Applications of Ecological Economics. Island Press, Washington, DC, pp 223-248

O'Hare P, White I, Connelly A (2016) Insurance as maladaptation: Resilience and the "business as usual" paradox. Environ. Plan. C Gov Policy 34:1175–1193. doi: 10.1177/0263774X15602022

Newig J, Fritsch O (2009) Environmental governance: participatory, multi-level – and effective? Environ. Policy Governance 19:197–214. doi: 10.1002/eet.509

Newig J, Koontz TM (2014) Multi-level governance, policy implementation and participation: the EU's mandated participatory planning approach to implementing environmental policy. J. Eur. Public Policy 21:248–267. doi: 10.1080/13501763.2013.834070

Nicholson-Cole S, O'Riordan T (2009). Adaptive governance for a changing coastline: Science, policy and publics in search of a sustainable future. In: Adger W, Lorenzoni I, O'Brien K (eds.). Adapting to Climate Change: Thresholds, Values, Governance. Cambridge, Cambridge University Press, pp 368-383

Niemeyer S, Spash CL (2001) Environmental Valuation Analysis, Public Deliberation, and their Pragmatic Syntheses: A Critical Appraisal. Environment and Planning C: Government and Policy 19:567–585. doi: 10.1068/c9s

Norgaard RB (2010) Ecosystem services: From eye-opening metaphor to complexity blinder. Ecol. Econ 69:1219–1227. doi: 10.1016/j.ecolecon.2009.11.009

Nye M, Tapsell S, Twigger-Ross C (2011) New social directions in UK flood risk management: moving towards flood risk citizenship? J. Flood Risk Manage 4:288–297. doi: 10.1111/j.1753-318X.2011.01114.x

Office for National Statistics (2015) ONS Population Estimates. Office for National Statistics. https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates. Accessed 18 August 2017

O'Donnell T (2016) Legal geography and coastal climate change adaptation: the Vaughan litigation. Geogr. Res 54:301–312

O'Hara SU (1996) Discursive ethics in ecosystems valuation and environmental policy. Ecol. Econ 16:95–107. doi: 10.1016/0921-8009(95)00085-2

Olsson P, Folke C (2001) Local Ecological Knowledge and Institutional Dynamics for Ecosystem Management: A Study of Lake Racken Watershed, Sweden. Ecosyst 4:85–104. doi: 10.1007/s100210000061

OPERAs (2016) Cultural mapping along the Inner Forth. OPERAs. http://operas-project.eu/talkingforth. Accessed 10 May 2018

O'Neill J (2001) Representing People, Representing Nature, Representing the World. Environ. Plan. C Gov. Policy 19:483–500. doi: 10.1068/c12s

O'Riordan T, Jordan A (1999) Institutions, climate change and cultural theory: towards a common analytical framework. Glob. Environ. Chang 9:81–93. doi: 10.1016/S0959-3780(98)00030-2

Ostrom E (1994) Rules, games, and common-pool resources. University of Michigan Press, Ann Arbor, 369pp

Ostrom E (2005) Understanding Institutional Diversity. Princeton University Press, Oxford, 376 pp

Ostrom E (2009) A General Framework for Analyzing Sustainability of Social-Ecological Systems. Sci. 325:419–422. doi: 10.1126/science.1172133

Ostrom E (2015) Governing the commons: the evolution of institutions for collective action. Cambridge University Press, Cambridge, 280pp

Oxford English Dictionary Online (2017a) Norm, n.1. Oxford University Press. http://www.oed.com/view/Entry/128266. Accessed 21 June 2017

Oxford English Dictionary Online (2017b) Institution, n. Oxford University Press. http://www.oed.com/view/Entry/97110. Accessed 21 June 2017

Paavola J, Adger WN (2006) Fair adaptation to climate change. Ecol. Econ 56:594–609. doi: 10.1016/j.ecolecon.2005.03.015

Pascual U, Balvanera P, Díaz S, Pataki G, Roth E, Stenseke M, Watson RT, Dessane EB, Islar M, Kelemen E, Maris V (2017) Valuing nature's contributions to people: the IPBES approach. Curr. Opin. Environ. Sustain 26–27:7–16. doi: 10.1016/j.cosust.2016.12.006

Penning-Rowsell EC, Johnson C (2015) The ebb and flow of power: British flood risk management and the politics of scale. Geoforum 62:131–142. doi: 10.1016/j.geoforum.2015.03.019

Persson C (2013) Deliberation or doctrine? Land use and spatial planning for sustainable development in Sweden. Land Use Policy 34:301–313. doi: 10.1016/j.landusepol.2013.04.007

Petts J (2007) Learning about learning: lessons from public engagement and deliberation on urban river restoration. The Geographical Journal 173:300–311. doi: 10.1111/j.1475-4959.2007.00254.x

Pirie D (2017) Taking Stock - Where we are now. Conference Presentation at the Sniffer Flood Risk Management Conference 2017. Sniffer. https://www.sniffer.org.uk/flood-risk-management-conference-2017. Accessed 16 June 2017

Poe G, K. Giraud K., Loomis J (2005) Computational methods for measuring the difference of empirical distributions. Am. J. Agric. Econ 87: 353-365. doi: 10.1111/j.1467-8276.2005.00727.x

Poe MR, Norman KC, Levin PS (2014) Cultural Dimensions of Socioecological Systems: Key Connections and Guiding Principles for Conservation in Coastal Environments. Conserv. Lett 7:166–175. doi: 10.1111/conl.12068

Pohl C, Rist S, Zimmermann A, Fry P, Gurung GS, Schneider F, Speranza CI, Kiteme B, Boillat S, Serrano E, Hadorn GH, Wiesmann U (2010) Researchers' roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. Sci Public Policy 37:267–281. doi: 10.3152/030234210X496628

Popper KR (1963) Conjectures and refutations: the growth of scientific knowledge. Routledge & KPaul, London, 412 pp

Porter JJ, Demeritt D, Dessai S (2015) The right stuff? informing adaptation to climate change in British Local Government. Global Environ. Change 35:411–422. doi: 10.1016/j.gloenvcha.2015.10.004

Poteete A (2010). Analyzing the politics of natural resources: From theories of property rights to institutional analysis and beyond. In: Vaccaro I, Smith E, Aswani S (eds) Environmental Social Sciences: Methods and Research Design, Cambridge University Press, Cambridge, pp 57-79

Potschin M, Haines-Young R, Fish R, Turner RK (2016) Routledge Handbook of Ecosystem Services. Routledge, 658 pp

Provencher B, RC Bishop (2004) Does Accounting for Preference Heterogeneity Improve the Forecasting of a Random Utility Model? J Environ. Econ. Manag 48:793–810. doi: 10.1016/j.jeem.2003.11.001

Radcliffe-Brown AR (1935) On the Concept of Function in Social Science. Am. Anthropol. 37:394–402

Rantanen H, Kahila M (2009) The SoftGIS approach to local knowledge. J Environ. Manag 90:1981–1990. doi: 10.1016/j.jenvman.2007.08.025

Raymond CM, Fazey I, Reed MS, Stringer LC, Robinson GM, Evely AC (2010) Integrating local and scientific knowledge for environmental management. J. Environ. Manage 91:1766–1777. doi: 10.1016/j.jenvman.2010.03.023

Reed MS (2008) Stakeholder participation for environmental management. Biol. Conserv 141:2417–2431. doi: 10.1016/j.biocon.2008.07.014

Reed MS, Evely A, Cundill G, Fazey I, Glass J, Laing A, Newig J, Parrish B, Prell C, Raymond C, Stringer L (2010) What is Social Learning? Ecol. Soc 15:1. doi: 10.5751/ES-03564-1504r01

Reed MS, Vella S, Challies E, de Vente J, Frewer L, Hohenwallner-Ries D, Huber T, Neumann RK, Oughton EA, Sidoli del Ceno J, van Delden H (2018) A theory of participation: what makes stakeholder and public engagement in environmental management work? Restor. Ecol 26:S7–S17. doi: 10.1111/rec.12541

Renn O, Webler T, Wiedemann P (1995) A Need for Discourse on Citizen Participation: Objectives and Structure of the Book. In: Renn O, Webler T, Wiedemann P (eds) Fairness and Competence in Citizen Participation. Springer, Dordrecht, pp 1–15

Renn O, Schweizer P-J (2009) Inclusive risk governance: concepts and application to environmental policy making. Environ. Policy Governance 19:174–185. doi: 10.1002/eet.507

Rennie AF, Hansom JD (2011) Sea level trend reversal: Land uplift outpaced by sea level rise on Scotland's coast. Geomorph 125:193–202. doi: 10.1016/j.geomorph.2010.09.015

Reyers B, Biggs R, Cumming GS, Elmqvist T, Hejnowicz AP, Polasky S (2013) Getting the measure of ecosystem services: a social–ecological approach. Front. Ecol. Environ 11:268–273. doi: 10.1890/120144

Richardson BJ, Razzaque J (2006) Public participation in environmental decision-making. In: Richardson BJ, Wood S (eds) Environmental Law for Sustainability. Hart Publishing, Oxford, pp 165–194

Ritchie J, Lewis J (2003) Qualitative research practice: a guide for social science students and researchers. SAGE Publications, Los Angeles, 336 pp

Rulleau, B., & Rey-Valette, H. (2013). Evaluating the benefits of beach protection measures in the face of climate change: The case of Languedoc-Roussillon (France). Journal of Environment Economics and Policy, 2, 133–147. doi: 10.1080/21606544.2013.776213

Robinson J, Clouston B, Suh J, Chaloupka M (2008) Are citizens' juries a useful tool for assessing environmental value? Environ. Conserv 35:351–360. doi: 10.1017/S0376892908005213

Roca E, Villares M (2012) Public perceptions of managed realignment strategies: The case study of the Ebro Delta in the Mediterranean basin. Ocean Coast. Manag 60:38–47. doi: 10.1016/j.ocecoaman.2012.01.002

Roller MR (2015) Applied qualitative research design: a total quality framework approach. The Guilford Press, New York, 398 pp

Roebeling PC, Costa L, Magalhães-Filho L, Tekken V (2013) Ecosystem service value losses from coastal erosion in Europe: Historical trends and future projections. J Coast. Conserv 17:389-395. doi: 10.1007/s11852-013-0235-6

Rogers S, Kaiser M, Jennings S (1998) Ecosystem effects of demersal fishing: A European perspective. In: Dorsey EM, Pederson J (eds) Effects of Fishing Gear on the Sea Floor of New England. Conservation Law Foundation, Boston, pp 68-79

Saarikoski H, Mustajoki J, Barton DN, Geneletti D, Langemeyer J, Gomez-Baggethun E, Marttunen M, Antunes P, Keune H, Santos R (2016) Multi-criteria decision analysis and cost-benefit analysis: Comparing alternative frameworks for integrated valuation of ecosystem services. Ecosys. Serv 22:238-49. doi: 10.1016/j.ecoser.2016.10.014

Sagoff M (1986) Values and preferences. Ethics 96: 301-316 doi: 10.1086/292748

Sagoff M (1988) The economy of the earth: philosophy, law, and the environment. Cambridge University Press, Cambridge, 271 pp

Sagoff M (1998) Aggregation and deliberation in valuing environmental public goods: A look beyond contingent pricing. Ecol. Econ 24:213–230. doi: 10.1016/S0921-8009(97)00144-4

Le Saout S, Hoffmann M, Shi Y, Hughes A, Bernard C, Brooks TM, Bertzky B, Butchart SH, Stuart SN, Badman T, Rodrigues AS (2013) Protected Areas and Effective Biodiversity Conservation. Sci 342:803–805. doi: 10.1126/science.1239268

Satterfield T, Gregory R, Klain S, Roberts M, Chan KM (2013) Culture, intangibles and metrics in environmental management. J Environ. Manag 117:103–114. doi: 10.1016/j.jenvman.2012.11.033

Sattler C, Matzdorf B (2013) PES in a nutshell: From definitions and origins to PES in practice—Approaches, design process and innovative aspects. Ecosyst. Serv 6:2–11. doi: 10.1016/j.ecoser.2013.09.009

Scarano FR (2006) Plant community structure and function in a swamp forest within the Atlantic rain forest complex: a synthesis. Rodriguésia 57:491–502

Scavia D, Field JC, Boesch DF, Buddemeier RW, Burkett V, Cayan DR, Fogarty M, Harwell MA, Howarth RW, Mason C, Reed DJ, Royer TC, Sallenger AH, Titus JG (2002) Climate Change Impacts on U. S. Coastal and Marine Ecosystems. Estuaries 25:149-164. doi: 10.1007/BF02691304

Schmidt K, Walz A, Martín-López B, Sachse R (2017) Testing socio-cultural valuation methods of ecosystem services to explain land use preferences. Ecosyst. Serv 26:270–288. doi: 10.1016/j.ecoser.2017.07.001

Schwartz SH (1992) Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries. In: Zanna MP (ed) Advances in Experimental Social Psychology. Academic Press, pp 1–65

Scottish Borders Council (2016) Land Use Framework for Scottish Borders. Scottish Borders Council. https://www.scotborders.gov.uk/info/20013/environment/723/biodiversity/5. Accessed 26 October 2016

Scottish Government (2014) Scottish Planning Policy. Scottish Government. http://www.gov.scot/Publications/2014/06/5823. Accessed 16 June 2017

Scottish Government (2016a) Scottish Index of Multiple Deprivation. http://simd.scot/2016/#/simd2016/BTTTFTT/9/-4.0000/55.9000. Accessed 28 July 2017

Scottish Government (2016c) Flood Risk Management (Scotland) Act 2009. Scottish Government. http://www.gov.scot/Topics/Environment/Water/Flooding/FRMAct. Accessed 16 June 2017

Scottish Government (2016b) Draft Budget 2016. http://www.gov.scot/Publications/2015/12/9056/8. Accessed 11th October 2017

Scottish Government (2016d) Scotland's People Annual Report: Results from the 2015 Household Survey. Local Authorities Tables 2015. Clackmannanshire. http://www.gov.scot/Resource/0050/00509166.pdf. Accessed 25 January 2018

Scottish Government (2017a) 2015 and 2016 CAP Payments to agricultural, forestry and rural businesses operating in Scotland. http://www.gov.scot/Topics/farmingrural/Agriculture/grants/LatestPayments. Accessed 25 January 2018

Scottish Government (2017b) A National Statistics publication for Scotland. Annual Estimates of Scottish Farm Business Income (FBI) 2015-16. http://www.gov.scot/Resource/0051/00517185.pdf Accessed 25 January 2018

Scottish Natural Heritage (2011) Firth of Forth - Site of Special Scientific Interest: Site Management Statement. Scottish Natural Heritage. http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8163#links. Accessed 19 August 2017

Shapansky B, Adamowicz WL, Boxall PC (2008) Assessing information provision and respondent involvement effects on preferences. Ecol. Econ 65:626–635. doi: 10.1016/j.ecolecon.2007.08.012

Shi J, Visschers VHM, Siegrist M, Arvai J (2016) Knowledge as a driver of public perceptions about climate change reassessed. Nat. Climate Change doi: 10.1038/nclimate2997

Shogren JF (2006) Valuation in the Lab. Environ Resourc. Econ 34:163–172. doi: 10.1007/s10640-005-3785-8

Silverman D (2013) A very short, fairly interesting and reasonably cheap book about qualitative research, SAGE Publications, London, 175 pp

Silvertown J (2015) Have Ecosystem Services Been Oversold? Trends Ecol. Evolut 30:641–648. doi: 10.1016/j.tree.2015.08.007

Sinclair-Chapman V, Walker RW, Gillion DQ (2009) Unpacking civic participation: Analyzing trends in black [and white] participation over time. Elect. Stud 28:550–561. doi: 10.1016/j.electstud.2009.05.026

Small C, Nicholls RJ (2003) A Global Analysis of Human Settlement in Coastal Zones. J Coast. Res 19:584-599

Smout TC, Stewart M (2012) The Firth of Forth: An Environmental History. Birlinn, Edinburgh, 305 pp

Spalding MD, McIvor AL, Beck MW, Koch EW, Möller I, Reed DJ, Rubinoff P, Spencer T, Tolhurst TJ, Wamsley TV, Wesenbeeck BK (2014) Coastal Ecosystems: A Critical Element of Risk Reduction. Conserv. Lett. 7:293–301. doi: 10.1111/conl.12074

Spash CL (2007) Deliberative monetary valuation (DMV): Issues in combining economic and political processes to value environmental change. Ecol. Econ 63:690–699. doi: 10.1016/j.ecolecon.2007.02.014

Spencer KL, Harvey GL (2012) Understanding system disturbance and ecosystem services in restored saltmarshes: Integrating physical and biogeochemical processes. Estuar. Coast. Shelf Sci 106:23-32. doi: 10.1016/j.ecss.2012.04.020

Stephens EM, Edwards TL, Demeritt D (2012) Communicating probabilistic information from climate model ensembles—lessons from numerical weather prediction. Wiley Interdiscip. Rev. Clim. Chang 3: 409–426. doi: 10.1002/wcc.187

Stern PC, Fineberg HV (1996) Understanding risk: informing decisions in a democratic society. National Academy Press, Washington DC, 249 pp

Stern PC, Dietz T, Abel T, Guagnano GA, Kalof L (1999) A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism. Hum. Ecol. Rev 6:81–97

Stirling Council (2017) Carse of Stirling Project. Stirling Council. http://my.stirling.gov.uk/services/community-life-and-leisure/community-information/stirling-carse. Accessed 19 August 2017

Stoker G (1998) Governance as theory: five propositions. Int. Soc. Sci. J 50:17–28. doi: 10.1111/1468-2451.00106

Straits BC, Singleton R (2011) Social research: approaches and fundamentals. Oxford University Press, Oxford, 595 pp

Swart R, Biesbroek R, Lourenço TC (2014) Science of adaptation to climate change and science for adaptation. Front. Environ. Sci doi: 10.3389/fenvs.2014.00029

Tadaki M, Sinner J, Chan K (2017) Making sense of environmental values: a typology of concepts. Ecol. Soc 22:. doi: 10.5751/ES-08999-220107

Talen E (2000) Bottom-Up GIS. Journal of the American Planning Association 66:279–294. doi: 10.1080/01944360008976107

Tippett J, Searle B, Pahl-Wostl C, Rees Y (2005) Social learning in public participation in river basin management—early findings from HarmoniCOP European case studies. Environ. Sci. Policy 8:287–299. doi: 10.1016/j.envsci.2005.03.003

Train KE (2009) Discrete choice methods with simulation. Cambridge University Press, Cambridge, 388 pp

Turner RK, Burgess D, Hadley D, Coombes E, and Jackson N (2007) A cost-benefit appraisal of coastal managed realignment policy. Glob. Environ. Change 17:397-407. doi: 10.1016/j.gloenvcha.2007.05.006

UK Committee on Climate Change (2016) UK Climate Risk Assessment 2017. Committee on Climate Change. https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017. Accessed 16 June 2017

Urama KC, Hodge I (2006) Participatory Environmental Education and Willingness to Pay for River Basin Management: Empirical Evidence from Nigeria. Land Econ 82:542–561. doi: 10.3368/le.82.4.542

Vatn A (2004) Environmental valuation and rationality. Land Economics 80:1–18. doi: 10.2307/3147141

Vatn A (2009) An institutional analysis of methods for environmental appraisal. Ecol.Econ 68:2207–2215. doi: 10.1016/j.ecolecon.2009.04.005

Villamagna AM, Mogollón B, Angermeier PL (2014) A multi-indicator framework for mapping cultural ecosystem services: The case of freshwater recreational fishing. Ecol. Ind 45:255–265. doi: 10.1016/j.ecolind.2014.04.001

Völker M, Lienhoop N (2016) Exploring group dynamics in deliberative choice experiments. Ecol. Econ 123:57–67. doi: 10.1016/j.ecolecon.2016.01.006

Waller V, Farguharson K, Dempsey D (2016) Qualitative social research: contemporary methods for the digital age. SAGE Publications, London, 194 pp

Wamsler C (2017) Stakeholder involvement in strategic adaptation planning: Transdisciplinarity and co-production at stake? Environ. Sci. Policy 75:148–157. doi: 10.1016/j.envsci.2017.03.016

Wamsler C, Brink E (2014) Interfacing citizens' and institutions' practice and responsibilities for climate change adaptation. Urban Climate 7:64–91. doi: 10.1016/j.uclim.2013.10.009

Webler T, Kastenholz H, Renn O (1995) Public participation in impact assessment: A social learning perspective. Environ. Impact Assess. Rev 15:443–463. doi: 10.1016/0195-9255(95)00043-E

Weesie PDM, Van Andel J (2008) An Integrated Framework for the Instrumental Valuation of Nature. Rest. Ecol 16:1–4. doi: 10.1111/j.1526-100X.2007.00353.x

Wiborn P (2013) Nature's services. A guide for primary school on ecosystem services. WWF Sweden. http://www.wwf.se/source.php/1539893/Ecosystem-services-3.pdf. Accessed 19 August 2017

Wiering MA, Arts BJM (2006) Discursive Shifts in Dutch River Management: "Deep" Institutional Change or Adaptation Strategy? Hydrobiol 565:327–338. doi: 10.1007/s10750-005-5923-2

Wilson MA, Howarth RB (2002) Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. Ecol. Econ 41:431–443. doi: 10.1016/S0921-8009(02)00092-7

Wittmayer JM, Schäpke N (2014) Action, research and participation: roles of researchers in sustainability transitions. Sustain. Sci 9:483–496. doi: 10.1007/s11625-014-0258-4

Wolters M, Garbutt A, Bakker JP (2005) Salt-marsh restoration: evaluating the success of de-embankments in north-west Europe. Biol. Conserv 123:249–268. doi: 10.1016/j.biocon.2004.11.013

Wynberg R, Hauck M (2014) People, power, and the coast: a conceptual framework for understanding and implementing benefit sharing. Ecol. Soc 19(1):27. doi: 10.5751/ES-06250- 190127

Zhu X, Linham MM, Nicholls RJ (2010) Technologies for climate change adaptation-Coastal erosion and flooding. Danmarks Tekniske Universitet, Risø Nationallaboratoriet for Bæredygtig Energ. http://www.tech-action.org/Publications/TNA-Guidebooks. Accessed 19 August 2017

Zinn JO (2009) A Comparison of Sociological Theorizing on Risk and Uncertainty. In: Zinn JO (ed) Social theories of risk and uncertainty: an introduction. Blackwell Publications, Malden, pp 168-210

APPENDIX A.

Scoping: methods and results

A1. Methods

The scoping methods consisted of a statement scoring exercise (Box A1), a pebble distribution exercise (Box A2), and an open-ended interview (Box A3). The statement scoring exercise was used to gauge knowledge and views on tidal areas, climate change and flood risk. The pebble distribution exercise was used to gauge levels of awareness and views on coastal ecosystem services and biodiversity. Participants completed one, two or all three exercises, depending on the time available. Researchers also noted down language and terminology that participants were unfamiliar with to inform language used during the main valuation phase.

A2. Results

Findings from the statement scoring exercise (Figure A1) and interviews (Box A4 and A5) show that clear majority agrees that nature areas on the Inner Forth shoreline should be protected and restored. Views as to whether there is sufficient attention to nature conservation in Scotland were varied, as well as whether habitat loss in the Inner Forth was a problem. Majority of people indicated flood risk in the Inner Forth to be a problem.

Just over 50% of the participants believed climate change to affect the Inner Forth in the coming decades. Findings from the pebble distribution exercise suggest that participants viewed the existence and future improvements in wildlife habitat and regulating ecosystem services, apart from carbon storage, more important than cultural ecosystem services (Figures A2 and A3, Tables A1-A4).

Box A1. Scoping questionnaire – Statement scoring exercise

This questionnaire is about the Inner Forth area. Before we begin, please take a moment to look at the map provided, so you know where the Inner Forth is. We first invite you to answer the warm-up questions. Then, we will ask you to answer the main questionnaire, followed by a couple of background questions. This survey is expected to take 10-15 minutes. If you have time, we will then invite you to an interview that lasts 20 minutes. The information you provide is fully confidential and will be treated as such. Your participation is crucial for the success of this research. Now for the **warm-up questions**. Please tick only one of the boxes, and feel free to add any comments you may have.

1 I think the environmental health of the Inner Forth should be improved.

□Fully agree□ Somewhat agree □Neutral □Somewhat disagree □ Completely disagree □Do not know

2 I think the nature areas on the margins of the Inner Forth should be protected and restored.

□Fully agree□ Somewhat agree □Neutral □Somewhat disagree □ Completely disagree □Do not know

3 I think it is a problem that over half of natural coastal habitats have been lost to farming and industrial uses in the Inner Forth.

□Fully agree□ Somewhat agree □Neutral □Somewhat disagree □ Completely disagree □Do not know

4 I think it is a problem that areas near the Inner Forth are at medium and high risk of flooding.

High flood risk - 10% chance in any one year Medium flood risk - 0.5% chance in any one year

□Fully agree□ Somewhat agree □Neutral □Somewhat disagree □ Completely disagree □Do not know

5 I think there is sufficient attention to nature conservation and protection in Scotland.

□Fully agree□ Somewhat agree □Neutral □Somewhat disagree □ Completely disagree □Do not know

6 I believe the Inner Forth is likely to experience climate-related changes (precipitation, sea level rise, storms, flooding) in the coming decades.

□Fully agree□ Somewhat agree □Neutral □Somewhat disagree □ Completely disagree □Do not know

Box A2. Scoping questionnaire – pebble distribution exercise

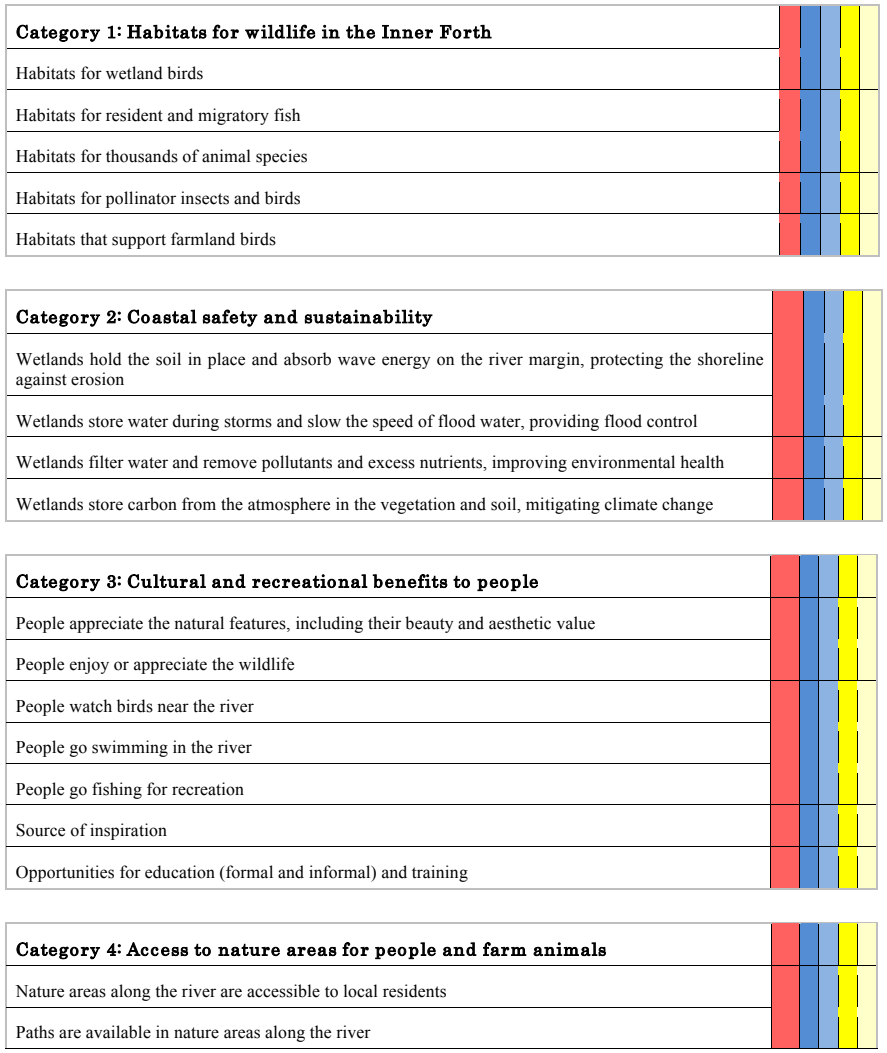
You have been provided with a list of landscape benefits that can be found in coastal areas (same as in Figure B2 in Appendix B). Please have a look at this list.

Do you think the following landscape benefits are found in the surroundings of the Inner Forth? If you think that it is found in the Inner Forth, add a tick in the red box. If you think it is not, leave it blank. If you are not sure about your opinion, add a question mark in the red box.

Next, think about how important these landscape benefits are in the Inner Forth. Is it important to have these landscape benefits in the Inner Forth shoreline? If these landscape benefits are not found in the area now, do you think it would be important to have them in the future? If you think it is important, add a tick in the first blue box.

Now, you are given 100 blue points, which you can give to different landscape benefits in the list. First allocate 100 points between the four different categories. Then allocate the points you have given to each of the categories between the landscape benefits in that category. Give more blue points to categories and landscape benefits that are important to you. Do not give any blue points to categories landscape benefits that are not important to you. Write the points you have given in the second blue box.

Next, we would like to know your opinion about future improvements in the coastal areas in the Inner Forth. If you think that it should be improved, add a tick in the first yellow box. Now, you are given 100 yellow points, which you can give to different landscape benefits in the list. Give yellow points to all categories and landscape benefits that should be improved in the area. If it is very important to improve, give it more yellow points. Do not give any yellow points to categories or landscape benefits that you think do not need to be improved. Write the points you have given in the second yellow box.



Box A3. Scoping interview questions

I will now ask a couple of questions about future improvement in the coastal area. There are no right answers to these questions. Try to think who according to you is responsible and what you think is the best way to go forward.

I would like to ask you a couple of questions relating to wildlife and habitats in the Inner Forth.

- Do you think there are habitats for wildlife in the Inner Forth area, and where are they?
- Is it important for you that there are habitats for plants and animals in the Inner Forth area, and why is that?
- Do you think the coastal areas in the Inner Forth provide habitats for wildlife, and do think that is important?

Now I would like to ask you a couple of questions relating to green spaces and recreation in the Inner Forth.

- Are there green spaces for available for people who live in the Inner Forth area, and do you know where these are?
- Is it important for you that there are green spaces in the Inner Forth area, and why is that?
- Do you think the coastal areas in the Inner Forth provide green spaces for the Inner Forth, and do think that is important?

Now I would like to ask you a couple of questions about what is special about the area and what makes Inner Forth the place it is.

- Is the Inner Forth valuable to you as a place, and why is that?
- If I asked you to describe the Inner Forth to me as a place, how would you describe it?
- Do you think it is important that people value Inner Forth as a place, and why is that?
- Do you think the coastal areas are an important part of the Inner Forth, and if so, why?

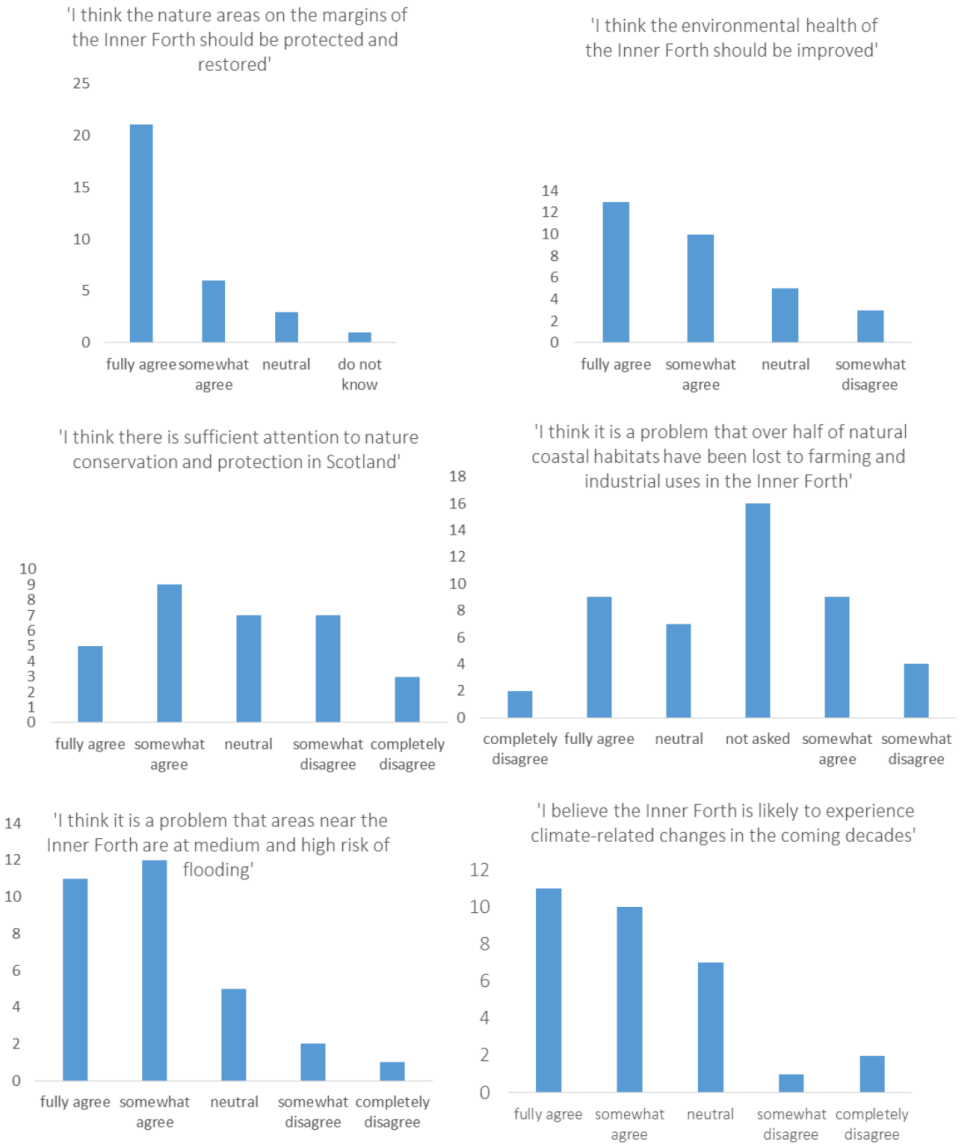


Figure A1. Results from the statement scoring exercise

Box A4. Existence and location of wildlife and green space in the coast in the Inner Forth, based on 13 interviews. Do you think the coastal areas in the Inner Forth provide habitats for wildlife, and do think that is important?

- I can imagine, there are areas that have been left for wildlife but I don't know where they are.
- I think it would be important to have wildlife but I don't think there are habitats for wildlife. Should organise hunts to protect birds (hunt species that prey birds)
- Don't know.
- I am sure they do, don't know where they are specifically. Important to have habitats, they are part of the heritage.
- I am aware that there are wetlands but not sure where they are. They are definitely important - poor birds have flown thousands of miles. And the habitats need to be suitable for their feeding requirements.
- Suppose they must, don't know.
- Don't go a lot as I don't have a car. Have seen seals in the sea near Edinburgh.
- I like the wildlife. I hope it's provided; we need the wildlife and the sealife.
- Yes, absolutely; they were there first. We need to find our place alongside nature. We need to resist this Victorian view of controlling nature, and its implicit hierarchies.
- Birds go where they feel it's best to go. [Don't need to provide them with habitat.] We've got a big seagull problem in places that aren't even on the seaside. But should still keep it [the coastal areas] as natural as possible.
- Certain places do, e.g. marshland by Kincardine. There is also a pathway there. It is important because it maintains the environment.
- I've seen wildlife, yes, it is important. A lot of kids have probably never seen these things before.
- Yes, aye. water birds are things in the area, don't want to lose that. don't want things to disappear altogether. lots of different fish and fishes.

Box A5. Existence and location of wildlife and green space in the coast in the Inner Forth, based on 13 interviews. Do you think the coastal areas in the Inner Forth provide habitats for wildlife, and do think that is important?

- I can imagine, there are areas that have been left for wildlife but I don't know where they are.
- I think it would be important to have wildlife but I don't think there are habitats for wildlife. Should organise hunts to protect birds (hunt species that prey birds)
- Don't know.
- I am sure they do, don't know where they are specifically. Important to have habitats, they are part of the heritage.
- I am aware that there are wetlands but not sure where they are. They are definitely important - poor birds have flown thousands of miles. And the habitats need to be suitable for their feeding requirements.
- Suppose they must, don't know.
- Don't go a lot as I don't have a car. Have seen seals in the sea near Edinburgh.
- I like the wildlife. I hope it's provided; we need the wildlife and the sealife.
- Yes, absolutely; they were there first. We need to find our place alongside nature. We need to resist this Victorian view of controlling nature, and its implicit hierarchies.
- Birds go where they feel it's best to go. [Don't need to provide them with habitat.] We've got a big seagull problem in places that aren't even on the seaside. But should still keep it [the coastal areas] as natural as possible.
- Certain places do, e.g. marshland by Kincardine. There is also a pathway there. It is important because it maintains the environment.
- I've seen wildlife, yes, it is important. A lot of kids have probably never seen these things before.
- Yes, aye. water birds are things in the area, don't want to lose that. don't want things to disappear altogether. lots of different fish and fishes.
- Yes, place of leisure, quite a lot of sea life.
- Important to see different environments, good for children to experience different places

Figure 2. Results from the pebble distribution exercise for relative importance of future improvement for coastal ecosystem services and biodiversity. Participants were asked to allocate 100 points across the attributes to indicate their relative importance in terms of future improvements. Average proportion and standard error of the mean was calculated for each attribute.

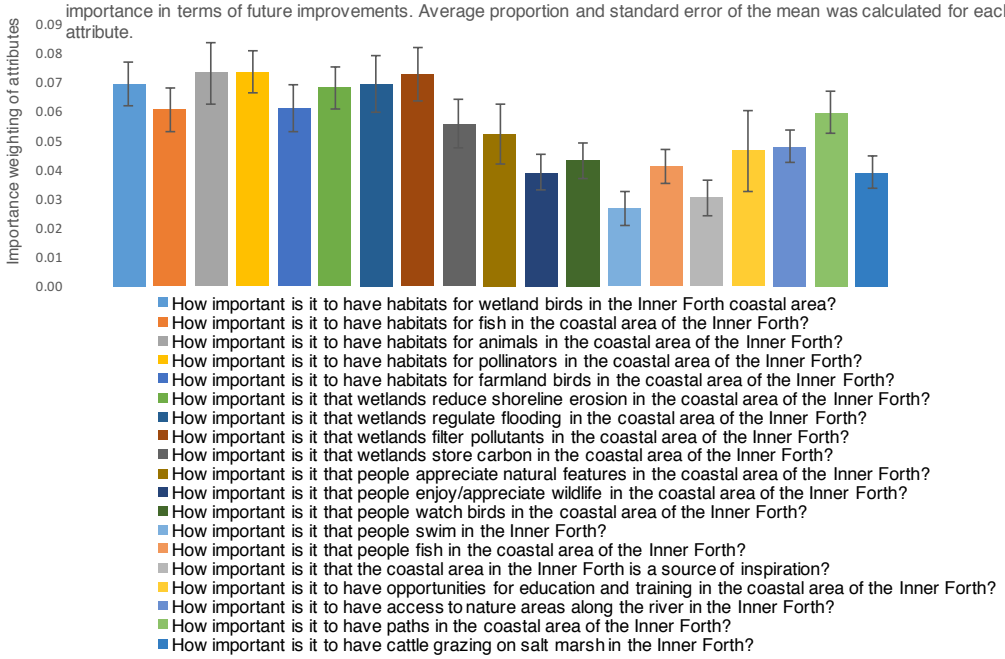


Figure 3. Results from the pebble distribution exercise for relative importance of different coastal ecosystem services and biodiversity. Participants were asked to allocate 100 points across the attributes to indicate their relative importance in the Inner Forth. Average proportion and standard error of the mean was calculated for each attribute.

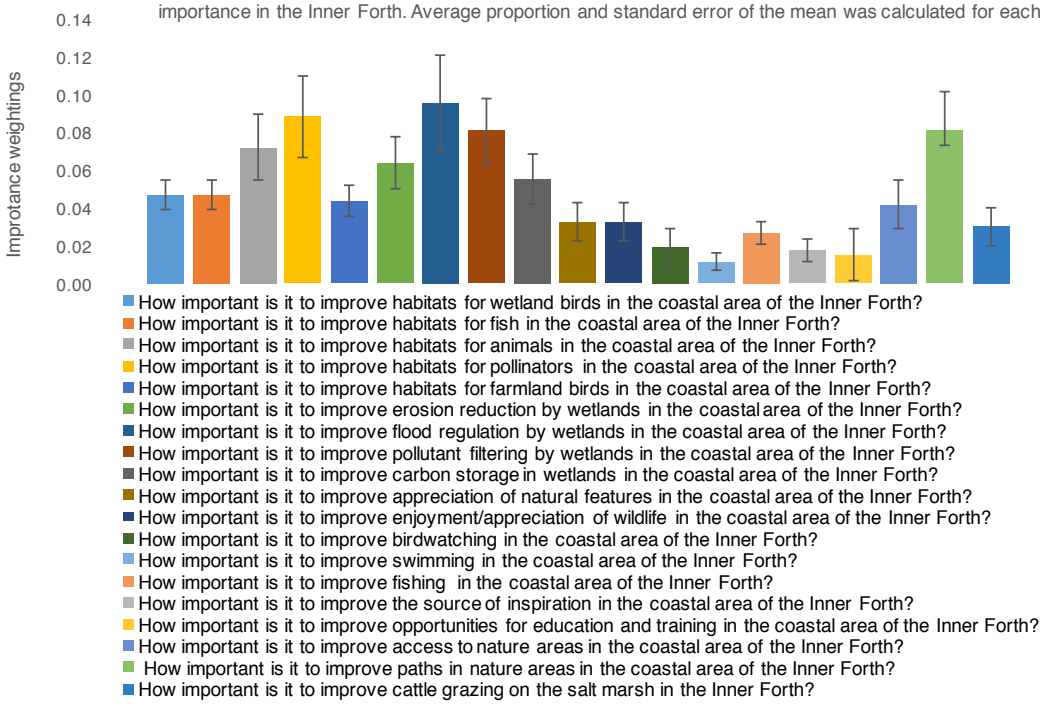


Table A1. Results from the pebble scoring exercise on the existence and importance of coastal habitats in the Inner Forth. The sample size for each question is in the rightmost column.

	Yes	No	Don't know	Total
Are there **habitats for wetland birds** in the Inner Forth shoreline?	77%	6%	16%	31
Is it important to have habitats for wetland birds in the Inner Forth shoreline?	93%	3%	3%	29
Should habitats for wetland birds be improved in the Inner Forth shoreline?	77%	14%	9%	35
Are there **habitats for fish** in the Inner Forth?	68%	13%	19%	31
Is it important to have habitats for fish in the Inner Forth shoreline?	86%	10%	3%	29
Should habitats for fish be improved in the Inner Forth shoreline?	69%	23%	9%	35
Are there **habitats for animal species** in the Inner Forth shoreline?	71%	16%	13%	31
Is it important to have habitats for animals in the Inner Forth shoreline?	93%	3%	3%	29
Should habitats for animals be improved in the Inner Forth shoreline?	86%	10%	3%	29
Are there **habitats for pollinators** (birds and insects) in the Inner Forth shoreline?	71%	10%	19%	31
Is it important to have habitats for pollinators in the Inner Forth shoreline?	86%	10%	3%	29
Should habitats for pollinators be improved in the Inner Forth shoreline?	69%	26%	6%	35
Are there **habitats for farmland birds** in the Inner Forth shoreline?	71%	6%	23%	31
Is it important to have habitats for farmland birds in the Inner Forth shoreline?	90%	7%	3%	29
Should habitats for farmland birds be improved in the Inner Forth shoreline?	66%	23%	11%	35

Table A2. Results from the pebble scoring exercise on the existence and importance of regulating ecosystem services in the Inner Forth. The sample size for each question is in the rightmost column.

	Yes	No	Don't know	Total
Do wetlands **reduce erosion** in the Inner Forth?	61%	19%	19%	31
Is it important for wetlands to reduce erosion in the Inner Forth shoreline	83%	7%	10%	29
Should erosion reduction by wetlands be improved in the Inner Forth shoreline?	71%	18%	11%	38
Do wetlands **regulate floods** in the Inner Forth?	68%	19%	13%	31
Is it important for wetlands to regulate flooding in the coastal areas in the Inner Forth	93%	3%	3%	29
Should flood regulation by wetlands be improved in the Inner Forth shoreline?	66%	26%	9%	35
Do wetlands **filter water** (pollutants and excess pollutants) in the Inner Forth?	61%	19%	19%	31
Is it important for wetlands to filter pollutants/excess nutrients in the coastal areas?	90%	7%	3%	29
Should pollutant filtering by wetlands be improved in the Inner Forth shoreline?	74%	17%	9%	35
Do wetlands **store carbon** in the Inner Forth?	72%	17%	10%	29
Is it important for wetlands to store carbon in the Inner Forth shoreline?	72%	17%	10%	29
Should carbon storage in wetlands be improved in the Inner Forth shoreline?	60%	26%	14%	35

Table A3. Results from the pebble scoring exercise on the existence and importance of cultural ecosystem services in the Inner Forth. The sample size for each question is in the rightmost column.

	Yes	No	Don't know	Total
Do people **appreciate natural features (aesthetics and beauty)** in the coastal area?	81%	19%	0%	31
Is it important that people appreciate natural features in the Inner Forth shoreline?	97%	3%	0%	29
Should appreciation of natural features be improved in the Inner Forth shoreline?	83%	17%	0%	35
Do people **appreciate/enjoy wildlife** in the Inner Forth shoreline?	90%	10%	0%	31
Is it important that people appreciate/enjoy wildlife in the Inner Forth shoreline?	100%	0%	0%	29
Should enjoyment/appreciation of wildlife be improved in the Inner Forth shoreline?	86%	14%	0%	35
Do people **watch birds** in the Inner Forth shoreline?	84%	13%	3%	31
Is it important that people watch birds in the coastal areas in the Inner Forth?	79%	17%	3%	29
Should birdwatching be improved in the Inner Forth shoreline?	77%	20%	3%	35
Do people **go swimming** in the Inner Forth shoreline?	32%	58%	10%	31
Is it important that people go swimming in the coastal areas in the Inner Forth?	55%	38%	7%	29
Should swimming be improved in the Inner Forth shoreline?	53%	44%	3%	34
Do people **fish (for recreation)** in the Inner Forth shoreline?	74%	16%	10%	31
Is it important that people go fishing in the coastal areas in the Inner Forth?	74%	16%	10%	31
Should fishing be improved in the Inner Forth shoreline?	68%	32%	0%	34
Is the Inner Forth coastal area **a source of inspiration** for people?	81%	16%	3%	31
Is it important that the coastal areas in the Inner Forth are a source of inspiration for people?	86%	14%	0%	29
Should the source of inspiration be improved in the Inner Forth shoreline?	74%	26%	0%	35
Does the coastal area in the Inner Forth provide **opportunities for education and training**?	77%	13%	10%	31
Is it important that the coastal areas provide opportunities for education and training?	86%	10%	3%	29
Should opportunities for education and training be improved?	83%	17%	0%	35

Table A4. Results from the pebble scoring exercise on the existence and importance of access to the river in the Inner Forth. The sample size for both questions is in the rightmost column.

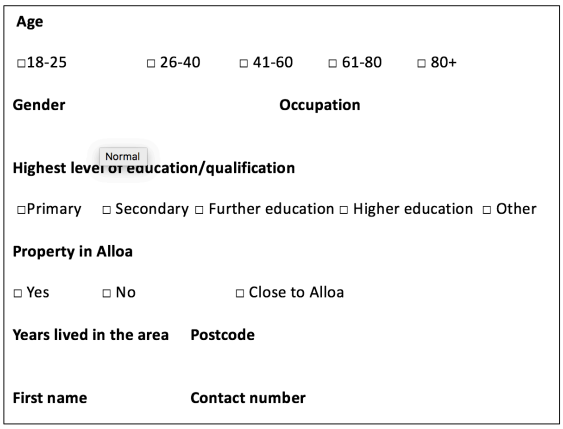
Are **the nature areas along the river accessible to local residents** in the Inner Forth?	70%	23%	7%	30
Is it important to have access to nature areas along the river in the Inner Forth?	97%	3%	0%	29
Should access to nature areas be improved in the Inner Forth shoreline?	74%	26%	0%	35
Are there **paths available in the nature areas** along the river in the Inner Forth?	68%	23%	10%	31
Is it important to have paths in the nature areas along the river	93%	7%	0%	29
Should paths in nature areas be improved in the Inner Forth shoreline?	80%	20%	0%	35

APPENDIX B.

Talking Forth workshops

Before the workshop activities, participants filled in the background questionnaire (Figure B1), and lead researcher explained the purpose and aims of the event to all workshop participants in plenary (Box B1).

The learning-based intervention (B2) addresses knowledge gaps regarding climate change impacts and adaptation on local level, and coastal flood and erosion regulating ecosystem services. These topics were chosen because the findings from the scoping phase suggest that Inner Forth citizens were not aware of the above-mentioned issues. Participants were generally aware of climate change, and drivers and trajectories of biodiversity loss (Figure A1 and Table A1 in Appendix A). It was therefore not necessary to raise awareness biodiversity losses and justify ecological needs for ecosystem restoration during the learning-based intervention.


Age

□18-25 □ 26-40 □ 41-60 □ 61-80 □ 80+

Gender **Occupation**

Normal

Highest level of education/qualification

□Primary □ Secondary □ Further education □ Higher education □ Other

Property in Alloa

□ Yes □ No □ Close to Alloa

Years lived in the area **Postcode**

First name **Contact number**

Figure B1. Background questionnaire

The discussion-based intervention was designed to address gaps in local awareness (Table B1). A list of ecosystem services and biodiversity was used in the discussion-based intervention (Figure B2).

Box B1. Information given to the participants regarding the workshop programme before the valuation exercises and deliberative interventions.

Workshop leader and the facilitators are introduced. Workshop leader explains why participants were invited (research topic, case study relevance, purpose of engaging with residents), who funds the research, and it is relevant locally (competing interests of land use, inclusion of local perspectives). Workshop leader also describes her personal research interests, and how they relate to the workshop topic. Participants are then told how they can best help the research team collect good quality data and information - by being honest, taking the courage to speak up and share their views during discussions. They are told that the discussions are audio recorded, so that 'we really get what you're saying and don't make mistakes'. The workshop leader also promises that the recordings will not be shared with anyone else, and that their names will not be associated with what they said during discussions. The participants will get paid at the end if they participate in all activities. Finally, everyone in the room introduces themselves and shares how long they have lived in the area.

Box B2. Learning-based intervention

I will now give you a short presentation about the coastal areas in the Inner Forth. The purpose of this talk is to give you information about the current situation in the coastal areas; the kinds of changes that are likely to happen in the coming decades; how these coastal areas have changed in the past; and the options that are available for adapting to coastal changes.

The Inner Forth area is defined by the water. One way in which the communities, farmers and industry are impacted by the water is flooding. There are three types of flooding that might take place in the Inner Forth. There is urban flooding: when there is heavy rainfall on paved surfaces, which do not drain much water. Then there is river flooding: when the river cannot cope with the amount of water entering it, for example during heavy rains and snow melting. Then there is coastal flooding, when the weather and tidal conditions increase sea levels.

(Continued)

(Continued)

Box B2. Learning-based intervention

Now please look at Figure 1 on your sheet. This map is from SEPA's website, and it shows you what the risk of coastal flooding is in the Alloa area. Look at the areas in green. The green areas show you areas where coastal flooding occurs once in every 10 years, so the likelihood of flooding in any one year is 10%. Alloa is over here on the map. You can look at these maps of flood risk on the SEPA website.

FIGURE 1
Areas with high likelihood of coastal flooding in the Alloa area

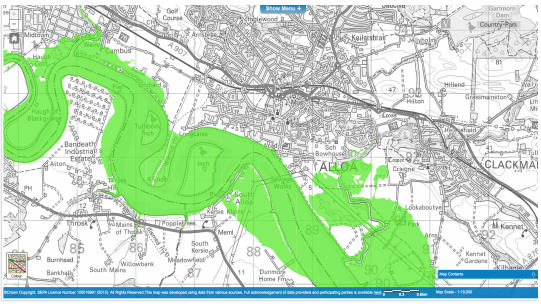
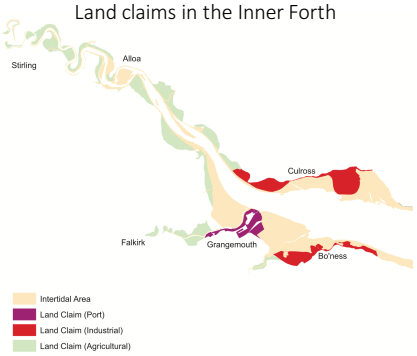


FIGURE 2
Land claims in the Inner Forth



People have lived and gained their livelihoods on the shores of the Inner Forth since the pre-historic times, and they've had to cope/adapt to seasonal and occasional flooding. Today, the communities, farmers and industry use coastal defences, like embankments and seawalls, to hold back the water when sea levels are higher. What is sometimes forgotten is that the coastal nature areas, such as salt marsh and mudflat also provide protection from flooding, act as a buffer between the sea and land, and store water during storm events, protect the seawalls behind them from erosion, so that they last longer without eroding.

In the Inner Forth, 50% of the original coastal nature areas have been lost, so these don't provide as much flood protection as they used to. These coastal habitats have been claimed from the sea, and are now used for farming, ports and industry. You can see in Figure 2 where land has been claimed from the sea, and what it is used for at the moment. I will let you have a look at this map for a moment. You can see that the foreshore between Stirling and Grangemouth has been claimed for farming. Grangemouth is also on reclaimed land. The foreshore towards the North Sea has been claimed for industrial uses. So the areas in green, red and purple were salt marsh and mudflat habitats 400 years ago.

(Continued)

(Continued)

The coast in the Inner Forth has always changed, both because of natural and human made changes, and it will continue to do so in the coming decades. Changes in climate are expected to rapidly impact the coast even further. The scientific community has collected a long record of historical climate data in Scotland, we can use this to understand what has already happened to our climate and what might happen in the future.

I have taken this diagram from the UK Climate Projections Webpage. This is Figure 3 in your sheet. This is a record of observations of temperature, and it shows how average yearly temperatures have changed in the past century. The record starts in 1900s and goes all the way up to 2000s. The black lines are the cool years, and the orange years are the warm years. You can see that there have been lots more warm years in the past decades. What is most important in this figure is the trend line. You can see that the trend line is rising.

You can see in Figure 4 that sea levels in the Inner Forth are expected to rise by about 20 cm by 2060. This is a so called central estimate – the evidence suggests that sea levels are just as likely to rise by less than 20 cm as they are to rise by more than 20cm. It is normal for sea levels to be high sometimes, for example when a storm is severe and there is a high tide at the same time. Over longer time scales, land has been rising in the Inner Forth since Ice Age. However, in the last century this process has been overtaken by sea level rise. Sea levels are rising today because land-based ice in Greenland is melting, which increases the volume of the ocean water. The second reason is thermal expansion - as water warms, it expands. As a result, sea level is rising in the Inner Forth and all future projections expect rates of sea level rise to accelerate.

FIGURE 3

Temperature trends for East Scotland

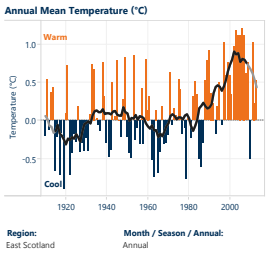
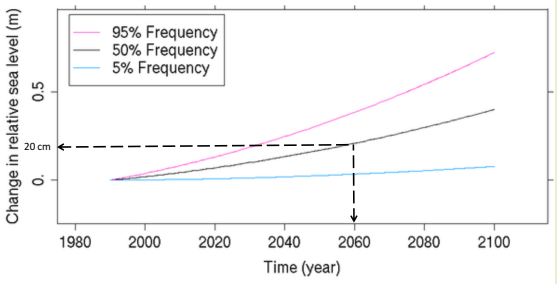


FIGURE 4

Sea-level rise in the Inner Forth



We don't know how much ice will melt and how quickly it will do so. We cannot be 100% confident about how much sea level will rise in the Inner Forth and how quickly. What we do know is that changes in sea levels are likely to impact flood events in the Inner Forth, and as sea levels rise, the flooding will reach further inland and further up. An event that was likely to occur every 100 years now might occur a lot more often in 2020. A severe storm that occurs now only once in every 100 years is predicted to occur every year by 2100. Let's take one more example. It sea level changes 5 mm per year, in 50 years the sea level will be 25 cm higher, which will raise the impact of future flood events.

The flood events are likely to last longer too. In other words, the floods of today will become more frequent and last longer. Unless flood defences are improved, they are likely to be overtopped.

There are a number of possibilities for making the Inner Forth coastal areas prepare for sea level rise and changes in flooding. The existing sea-walls and embankments can be maintained better and built higher. This might be needed in some coastal areas. However, it would be expensive to maintain and build artificial sea-walls all throughout the whole shoreline of the Inner Forth. This could also cause eroding in other parts of the estuary, making the shoreline more susceptible to coastal changes. Human-made flood defences will become a less cost-effective option when sea levels rise, as they need to be higher, and maintained more.

We can also restore salt marsh and mudflat habitats in the areas where they have been lost. These restored habitats would provide protection from coastal erosion and absorb water when the sea levels are high. We can use the map in Figure 2 as a clue as to where salt marsh habitats could be restored. These tidal habitats are of particular value in the coming decades when sea levels are going to rise at accelerating rates, and there is likely to be a lot more shoreline flooding during storms. If you put a stretch of salt marsh between the open water and the shoreline, the speed of waves will be slower, the waves coming in will be lower, and they will hit the shore with lower energy associated with them. Restoring these wetlands will reduce the cost of shoreline protection in the Inner Forth.

Topic	Purpose	Task	Questions
Local landscape	Share knowledge and views about locally important natural features.	Map and list locally important natural features and discuss why they visit and/or appreciate them.	Where do you visit or appreciate green spaces or spaces for nature? Green space is any land or water that has vegetation on it, for example gardens, parks, or paths. Spaces for nature could be any area or location where species can feed, rest, breed or grow. These species could be anything from mammals, insects, birds, fish, wild flowers or trees. Can you describe to me why you visit or appreciate these places? What is it that you like about them? What natural features do you associate with the Inner Forth that define it, and make it the place it is? We will focus on natural features rather than human-made features, for example: living things; landscapes; including coastal environments; special places; scenery; places and moments when you see beauty and enjoy your surroundings.
Coastal realignment	Share knowledge and views on the implications of converting land back to tidal areas.	Discuss and annotate a map with colour-coded stickers to indicate what changes they would like to see in potential sites for coastal realignment.	What kinds of changes in the coast would be important to you? We will discuss this and use colour-coded stickers to indicate our preferences on this map. Pick the colour of the sticker to indicate changes are important (Figure B2). Place the sticker over land parcels that would be important. You can place altogether ten stickers on the map. Why are these changes important to you? Why is this site important to you?
Future drivers of change in the shoreline	Learn and share concerns on future drivers in coastal areas, and how they are connected to ecosystem services and biodiversity.	List and discuss concerns for the future and use colour-coded stickers to indicate linkages with ecosystem services and biodiversity and identify top concerns.	Now we are now going to discuss changes happening either locally or globally. We will call these drivers of change. What kinds of changes, either happening locally or globally, do you think will impact these landscape benefits near the coast now or in the future? How do you think these drivers of change are connected to the different landscape benefits? Why? Which of these drivers are you most concerned about? Which of these drivers do you think are the biggest problem for the local community? Add a sticker next to three drivers that you are most concerned about.

Table B1. Discussion-based interventions

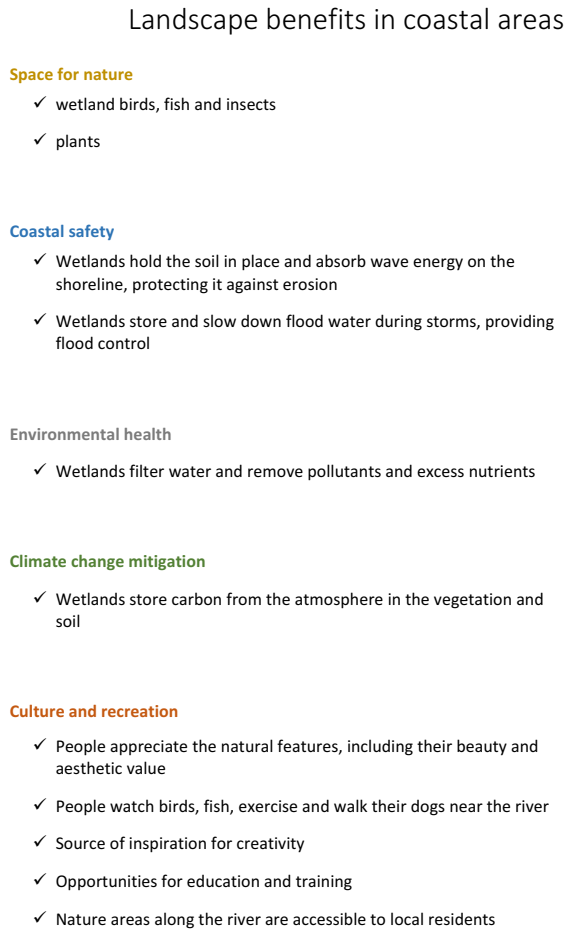


Figure B2. The list of ecosystem services and biodiversity

APPENDIX C.

The choice experiment

The design of the choice experiment was informed by the scoping phase and a pilot (Box C1). The scoping phase informed both the design of the choice experiment attributes and the language that was adopted for the main phase. For attributes, the scoping phase interviews revealed that many participants were not aware of the location of coastal and tidal habitats. To help address this local awareness gap, all participants were shown the existing locations of tidal marshes and mudflats before the exercise. For language, many participants were hesitant when asked about the presence of habitats in their local area, whereas many used phrases like 'nature' and 'space for nature'. This more common terminology was adopted for choice experiments and deliberative interventions in the main phase.

The choice experiment was explained in the same way to all participants (Box C2). They were told about the location, appearance, existing uses and bird numbers in shoreline areas; and the shoreline and monetary attributes in the choice experiment. Participants were prompted to avoid overestimating the monetary attribute and reassured that choosing options without donations was not a wrong answer. They were also prompted to consider the distance to the sites where attributes would change.

Table C1 outlines the design and reasons for including the shoreline and monetary attributes.

After the workshop participants had completed the third round of choice tasks, they were asked to fill in a follow-up questionnaire to gauge for changes in certainty during the workshop (Figure C1).

Box C1. Choice experiment pilot

The purpose of the choice experiment pilot was two-fold: to test whether choice cards were understandable, and estimate the range in proportional increase that participants are willing to pay for different attribute levels. A set of six choice tasks were carried out 17 participants in Alloa in June 2015. Participants were asked what they thought would be an appropriate proportional increase in council tax over a ten-year period for all six tasks. Ten percent of those who were approached to participate took part.

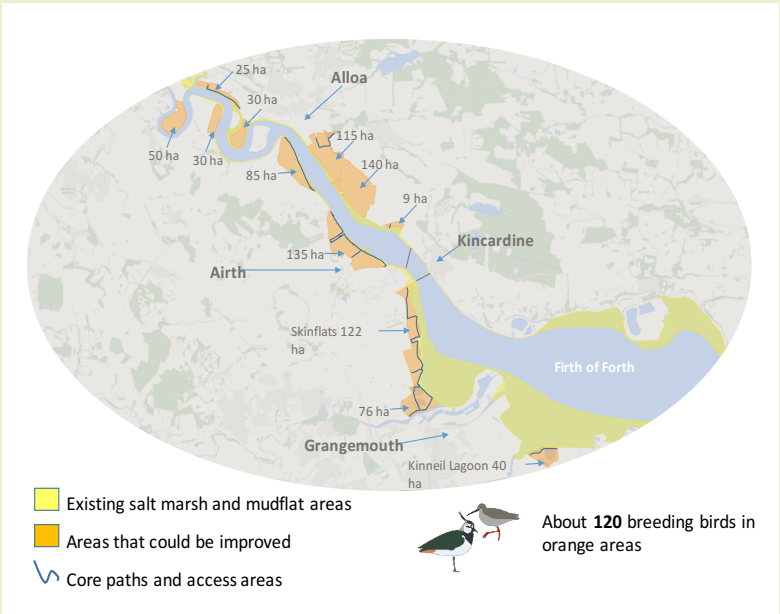
The researchers learned after several choice tasks that it was essential to provide a more elaborate explanation of the differences in attributes between scenarios, so that older participants and those with learning difficulties would comprehend.

Participants' WTP varied between zero and fifteen percent increase in council tax for different scenarios. Three out of seventeen were not willing to pay for changes, and one participant was undecided. For the remaining participants, average WTP varied between 1% and 12.5%, and standard error of the mean varied between three and five percent between choice tasks for those who were WTP.

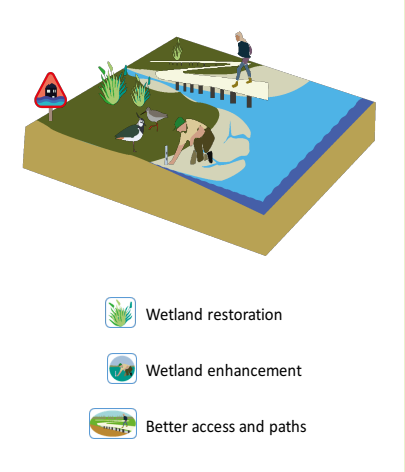
Box C2. Choice experiment

Before we start the task, I will share some background information and explain what we are asking you to do. Here is what tidal marshes and mudflats look like in the Inner Forth (below).

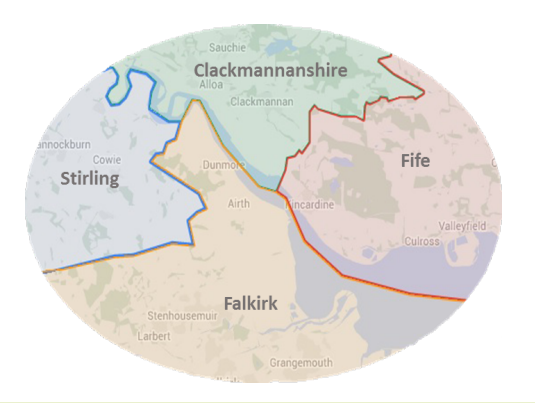
You can find these in areas that are marked in yellow on the map (right). I will give you a moment to look at these. The areas marked in orange, beside the areas marked in yellow, is what we are going to focus on in this interview. In these twelve parcels of land around the foreshore, it would be feasible to either bring back marshland, or manage marshland more actively, because it is currently in a degraded state. At the moment, these parcels of land are mainly used for farming or industrial purposes, apart from Skinflats and Kinneil Lagoons. Skinflats is an RSPB nature reserve, and Kinneil Lagoons is an industrial wasteland. There are paths in some of the areas but not in all of them. There are about 120 breeding bird pairs in the orange areas today.

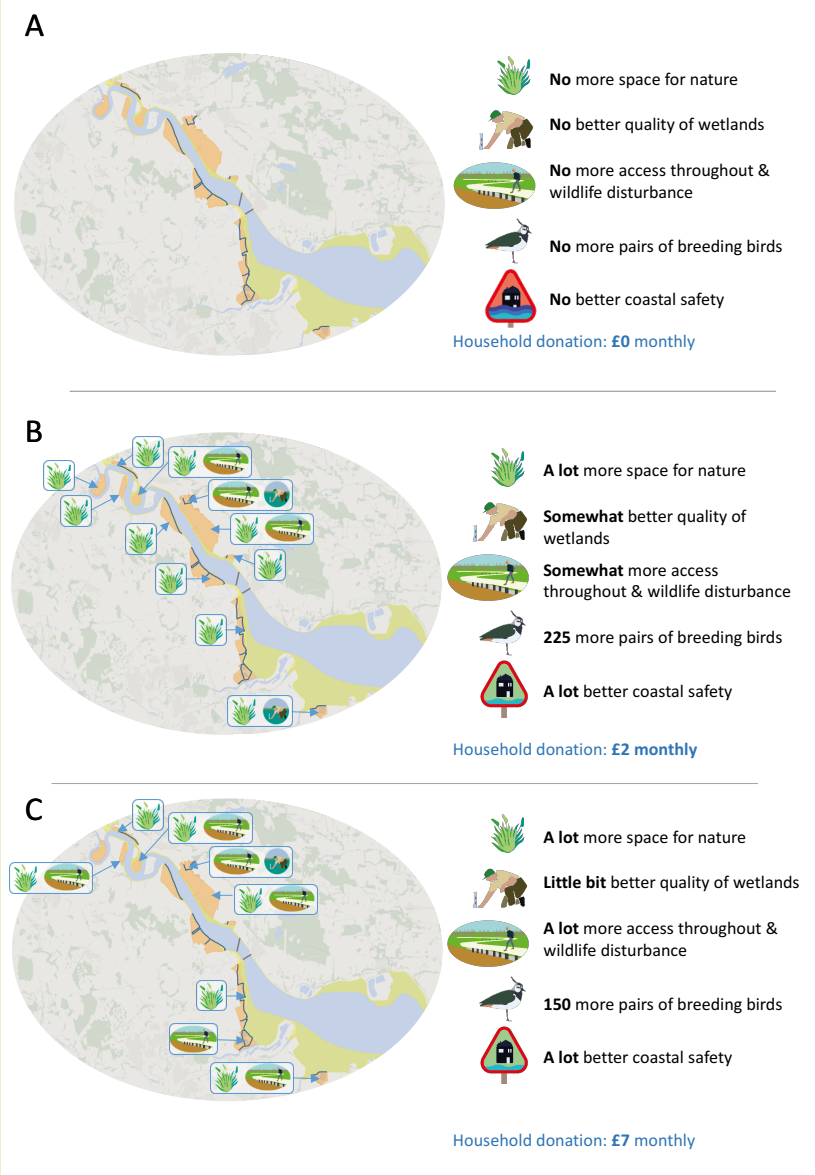


Now let's look at this illustration of a marshland area (below). We will be talking about three types of changes that could happen on an area like this. Firstly, you can restore marshland, which would lead to more space for nature, and increased coastal safety, because these marshes provide protection from flooding and coastal erosion. Secondly, you can bring in rangers to carry out existing conservation management on ecologically degraded marshland areas. He is doing things like installing sluices to raise water tables, so that this existing marsh area can support more fish and wetland birds. Thirdly, you can build new paths, or maintain paths that in poor condition, so that locals have increased access to the river, however, this might increase disturbance for local wildlife.



For the purpose of this exercise, want to know what would you be willing to donate for the coastal changes that we will look at. Think of this as a donation from your household on a monthly basis over five years. The donation would come from the households in these four council areas (below). It would go to the Inner Forth Landscape Initiative, which is a lottery funded landscape partnership.





So you can see that there is donation involved with each option. It is really important for our research that you consider the donation involved as if they were real. So you need to think about your household income and spending, and what you might need to give up to be able to afford a donation. People often choose options that involve a donation they would not make in reality. So that we get good quality data for our research, please treat this like a real situation. This might mean that you need to choose the option that does not involve any donation. This is not a wrong answer, so it is okay to choose an option that does not involve any changes. There is no right or wrong answer, it is about your opinion.

Attribute	Description	Changes in indicators	Reason to be included
Managed realignment	Salt marsh and mudflat habitats are restored through landward retreat of artificial flood defences, resulting in losses of farmland and industrial wasteland.	1. More space for nature 2. Lower flood and erosion risk 3. Increase in number of breeding wildfowl and waders	This attribute is central to the policy questions regarding managed retreat, and it has been suggested to be feasible on ten parcels of land in the area. Participants' preferences in both formats were expected to be sensitive to changes in this attribute, because of the widespread awareness and concerns regarding wildlife losses (Appendix A). Scoping phase participants perceived flood regulation to be the most important regulating service (93%), however, not as many knew if regulating services existed, or whether they should be improved (Table A2). Interview participants are expected to be less sensitive to changes in flood risk and erosion, as it was not a widespread concern amongst participants during scoping phase (Table A2).
Conservation actions	Rangers actively manage degraded tidal habitats by e.g. installing sluices and raising water tables (RSPB 2013).	1. Better ecological quality of tidal habitats 2. More breeding wildfowl and waders	Active conservation measures were included, as this is proposed to be a feasible on six tidal land parcels in the area. This would also contribute to similar conservation goals as tidal restoration, without trade-offs with agriculture and income for farmers.
Recreational paths	Walking and cycling routes are maintained where paths are in poor state and created where there are no existing paths (RSPB 2013).	3. More recreational access to the river 4. More disturbance for wildlife	Local feasibility study suggests that there are eleven parcels of land where there is no recreational access, or the paths are in poor condition. As appreciation and recreational opportunities in the Inner Forth area were widely valued by participants of the scoping phase (Table A3) and 80% of those who were asked said that paths along the river should be improved, it was expected that participants' preferences would be sensitive to changes in access in the choice experiment.
Monthly donation	Donation (5-year period) to the Inner Forth Landscape Initiative would be collected from residents from Clackmannanshire, Fife, Falkirk and Stirling.	5. Not connected to any of the indicators	

Table C1. Attributes in the choice experiment.

The choice options had different characteristics. Which characteristics did you take into account in making your choices? Tick all characteristics that you took into account.

- ☐ Sites where coastal nature is restored
- ☐ Sites where existing coastal nature is enhanced
- ☐ Sites where paths are created / upgraded
- ☐ Number of breeding bird pairs
- ☐ Space for nature
- ☐ Access / wildlife disturbance
- ☐ Coastal safety
- ☐ Donation per household
- ☐ The distribution of sites that are restored, i.e. how close or far they are from each other
- ☐ The distribution of sites that are enhanced, i.e. how close or far they are from each other
- ☐ The distribution of sites where paths are improved, i.e. how close or far they are from each other

Who did you consider when you were making a choice?

- ☐ Myself
- ☐ Family
- ☐ Community
- ☐ Family and myself
- ☐ Family and community
- ☐ Myself and community
- ☐ Family, community and myself
- ☐ I did not think about it

Did you feel that you changed your mind about your preferences for the coastal areas after the presentation on **'Coastal change in the Inner Forth'**?

☐ Yes ☐ No

Did you feel that you changed your mind about your preferences for the coastal areas after making maps?

☐ Yes ☐ No

Did you feel that you changed your mind about your preferences for the coastal areas after the discussion on **'Drivers of change in the Inner Forth'**?

☐ Yes ☐ No

On a scale 1-5, how certain were you about your choices during the first round of choice tasks? 1 is very uncertain and 5 is very certain. Tick a box below.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

On a scale 1-5, how certain were you about your choices during the third round of choice tasks? 1 is very uncertain and 5 is very certain. Tick a box below.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Choose a statement below that best describes why you became more or less certain about your choices:

- ☐ Learning more about the coastal areas
- ☐ Making maps of the Inner Forth
- ☐ I learned more about other people's opinions
- ☐ I had more experience in making choices between options

Were you aware that the choice situations were the same during first, second and third round of choice tasks?

☐ Yes ☐ No

If you were aware of this, did it affect your choices?

☐ Yes ☐ No ☐ I don't know

Figure C1. Follow-up questionnaire

APPENDIX D

Demographics of workshop and interview participants

Women were overrepresented by three percent in workshops and four percent in interviews (Table D1). Household owners were considerably underrepresented and tenants overrepresented in both formats. Highly educated were underrepresented in both formats, whereas those with secondary education were overrepresented. Ages 18-25 were overrepresented in both formats, whereas 26-40 were slightly overrepresented in

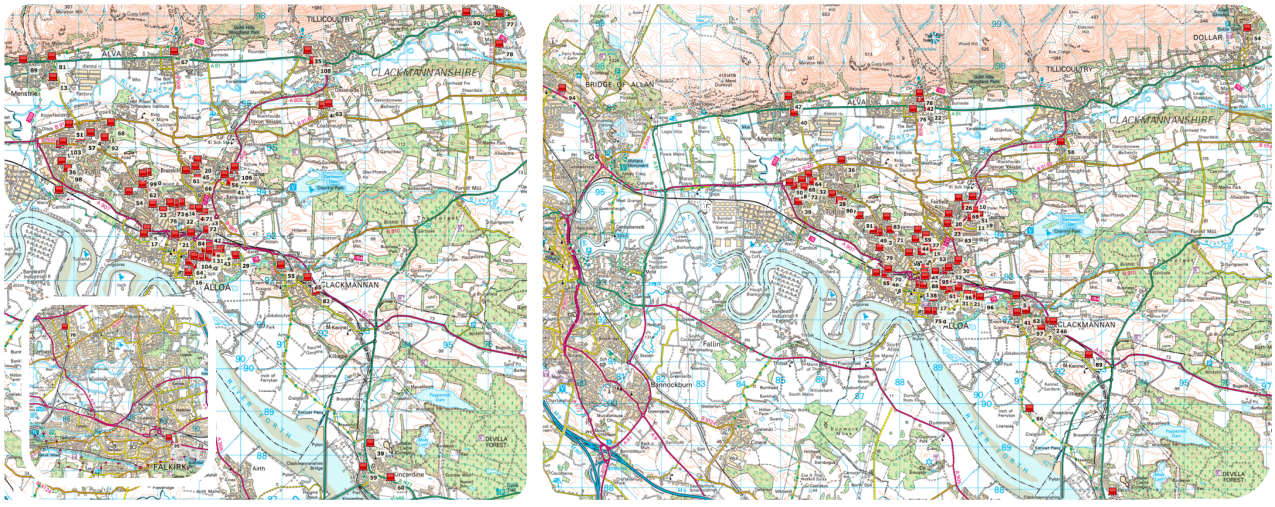


Figure D1. Geographical distribution of participants in workshops (left) and interviews (right)

workshops, and 61-80 in interviews. People over the age of 80 were underrepresented in both format, whereas ages 26-40 in interviews, and 41-60 and 61-80 in workshops. Employed were underrepresented in both formats, whereas students in interviews, and retired in workshops. Unemployed were considerably overrepresented in both formats.

Majority of all participants live in Alloa, within short walking distance from the areas where participants were recruited, interviewed and workshops were held (Figure D1). Overall, there are no considerable differences in geographic distribution of participants between workshops (left) and interviews (right). About 20% of workshop and 15% of interview participants live in South-East parts of Alloa, which were amongst the most deprived 10% areas in Scotland in 2016 (Scottish Index of Multiple Deprivation 2016). About 35% of workshop and 40% of interview participants live in areas of South-East Alloa ('bottom end'), Clackmannan, Sauchie, Tillicoultry and Tullibody, which fall within the 20% most deprived areas in Scotland. Five percent of workshop and two percent of interview participants live outside the Clackmannanshire area in Falkirk, Kincardine and Bridge of Allan. Out of 109 workshop participants, 108 were asked for their postcode, however 17 were not recognised. Out of 98 interview respondents, 97 provided their post code, and 11 post codes were not recognised.

Participants from associate professional roles (e.g. arts, environment and defence) were overrepresented in workshops. People in sales and customer service were overrepresented in interviews (Table D2).

		Format	Comparison		
		Workshop	**Interview**	**Clacks.**	**Scotland**
Gender[6]	Female	0.54	0.55	0.51	0.52
	Male	0.46	0.45	0.49	0.48
Household	Owner	0.36	0.53	0.63	0.61
	In Alloa	*0.17*	*0.30*	-	-
	Elsewhere	*0.19*	*0.24*	-	-
	Tenant	0.62	0.46	0.36	0.37
	Not asked	0.03	0.01	-	-
Education[7]	Higher	0.38	0.35	-	0.43
	Further	0.56	0.59	-	0.59
	Secondary	0.94	0.97	-	0.85
	Other	0.04	0.00	-	0.06
	Not asked	0.03	0.03	-	-
Age[8]	18-25	0.17	0.14	0.11	-
	26-40	0.23	0.18	0.21	-
	41-60	0.34	0.37	0.38	-
	61-80	0.22	0.29	0.26	-
	80+	0.03	0.02	0.05	-
	Not asked	0.02	0.00	-	-
Employment[9]	Employed	0.38	0.45	0.57	0.55
	Unemployed	0.32	0.23	0.12	0.14
	Student	0.07	0.03	0.07	0.08
	Retired	0.21	0.26	0.25	0.24
	Not asked	0.03	0.04	-	-

Table D1. Demographic statistics of workshop and interview participants.

SOC Major Group	*Sector*	*Workshop*	*Interview*	*Clackmann.*

[6] Comparative values retrieved from the Office for National Statistics (2015).

[7] Minimum level of education reported. Higher education corresponds to education at SVQ level 4; further education to SQV level 3; secondary to SQV level 1 and 2. Comparative values retrieved from the Office for National Statistics (2015).

[8] National Records of Scotland (2016)

[9] 'Employed' includes full-time, part-time and self-employed. 'Unemployed includes those who are seeking work; looking after the home or children; disabled or permanently sick; and short-term illness and injury. 'Student' includes those in further or higher education. Scottish Government (2016d)

Professional	Engineering, manufact., energy	7%	22%	
	Education	8%	8%	
	Health care	7%	6%	
	Academia	4%	1%	
	Religion and faith	0%	1%	
	Business, finance and accounting	5%	6%	
	Information technology	7%	0%	
	Total	**38%**	**44%**	**18±4%**
Associate professional and tech.	Art, design and culture	8%	4%	
	Environment and horticulture	4%	3%	
	Defence	3%	3%	
	Health and safety	5%	0%	
	Human resources	3%	1%	
	Total	**23%**	**11%**	**13±4%**
Caring, leisure and other service	Social services, housing and childcare	14%	13%	12±4%
Admin. and secretarial	Clerical or administrative	5%	11%	10±3%
Sales and customer service	Retail	4%	11%	
	Customer service and relations	4%	1%	
	Hospitality and catering	5%	6%	
	Total	**13%**	**18%**	**7±3%**
Process and machine op.	Transport and logistics	4%	0%	10±3%
Elementary	Property maintenance	3%	3%	9±3%

Table D2. The occupational statistics of the workshop and interview participants. ONS Crown Copyright Reserved. Retrieved from Nomis on 26 January 2017. Confidence 95%. Date: Oct 2015-Sep 2016.

APPENDIX E

The Inner Forth social-ecological system from a citizen perspective

E1. Methods: Analysis of citizen perspectives using the social-ecological system framework

The 'future drivers of change' discussions were transcribed, and transcripts were analysed to identify all drivers of change mentioned. We recorded all drivers of change in a spreadsheet; how many times they were mentioned by the groups; the location (if mentioned), linkage to other drivers; and how many times it was linked to different ecosystem services; and how many participants voted it as a top concern. It was also noted whether participants referred to its state, increase, decline, change or a combination of the above. Next, we assigned codes to all drivers of change in the spreadsheet according to social-ecological systems framework (Ostrom 2009).

The first tier of codes was based on the first-tier variables in social-ecological systems model, which were adapted from Ostrom (2009): social, economic and political settings, river system, governance, natural system, stakeholders, stakeholder actions and related ecosystems. The main difference to Ostrom (2009) is that resource system is reframed with river system, which considers the biophysical system in the Inner Forth. Resource units is reframed as the natural system, which considers parts of the river system with predominantly natural processes, such as salt marshes, mudflats, wildflower meadows and woodlands. Actors is reframed as stakeholders, and action situations reduced to only consider stakeholder actions, excluding performance measures within or beyond the

Inner Forth. Instead, the performance measures are considered as properties of the river system and related ecosystems. Next, we created and assigned second-tier codes, which were created whenever a new second-tier variable was needed. We counted frequency of mentions for different SES variables (both first-tier and second-tier), as well as the frequency of connections mentioned between first-tier variables and ecosystem services, as well as the frequency of concerns and priorities. We then visualised the differences in connectivity with other SES variables, ecosystem services, and overall concern in a set of diagrams based on the frequency counts.

E2. Results: citizen perspectives on the Inner Forth social-ecological system

During the third discussion-based intervention to address local awareness gaps, participants shared varying levels of knowledge regarding different variables in the Inner Forth social-ecological system, how they are linked (directly and via feedbacks), and impact coastal ecosystem services and biodiversity. Participants described all first-tier variables comprehensively, despite the short time available (15-20 min) and having done a number of other group exercises before this final discussion exercise. Out of all the second-tier variables, participants described pressures on the river system in most detail, resulting in altogether twenty third-tier variables.

E2.1 How knowledge was shared about the socio-ecological system

Participants shared a lot of knowledge regarding three linkages between the SES variables (Figure E1). Firstly, they described many ways in which stakeholder actions feed back to one another (Figure E6), the river system, and the stakeholder variables (Figure E5). Secondly, participants described a number of ways in which the stakeholder variables feed back to one another (Figure E6), but demonstrated less knowledge of how the stakeholder variables link to the actions they participate in (Figure E4), or feed back to governance (Figure E5). Thirdly, the participants described many ways in which the social, economic and political settings are linked to the Inner Forth (Figure E4).

Participants did not share any knowledge for two types of linkages between the SES variables. Firstly, they did not mention any internal dynamics of the social, economic and political settings, or how the Inner Forth affects the social, economic and political settings (Figure E5 and E6). Secondly, they did not describe how the governance dynamics affect one another, or how they are affected by stakeholder actions (E5 and E6). Furthermore, they shared little knowledge regarding the linkages with and within natural systems (Figure E1, E4, E5 and E6).

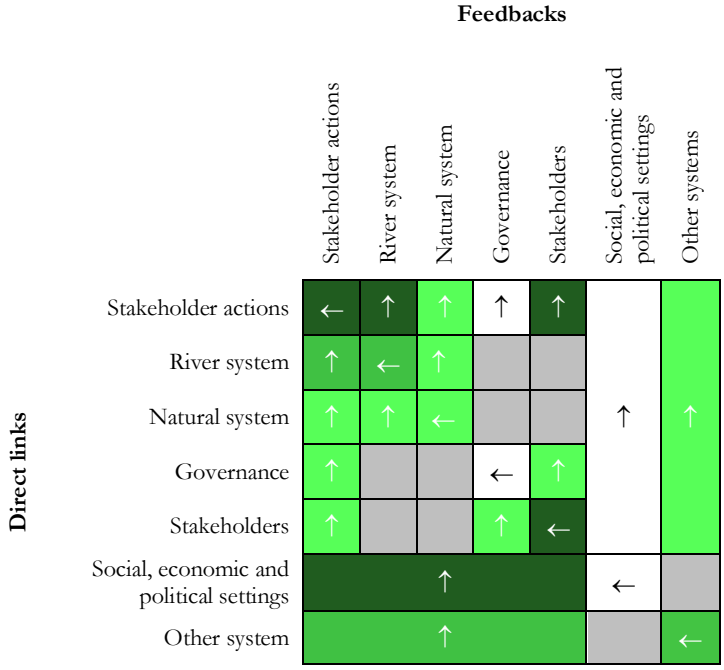


Figure E1. Overview of how workshop participants shared local knowledge on the linkages between SES variables. Dark green indicates linkages where participants described over ten different types of linkages; medium green indicates 5-9 different linkage types; light green indicates 1-4 different linkage types; white indicates that no linkage types were described. Grey indicates lack of direct links or feedbacks according to the social-ecological system.

E2.2 Impacts on ecosystem services and biodiversity

Participants shared knowledge on how SES variable impacts on ecosystem services and biodiversity by pointing out altogether 739 impacts, resulting in an average of 37 per group. Nearly half of the impacts were from actions taken by stakeholders, whereas governance and the natural system were perceived to have the least impact (Figure E2). Development, particularly for housing and industry, was the most often mentioned variable to impact all coastal ecosystem services and biodiversity, apart from water regulation (Figure E3). Flood and erosion control were perceived to be most impacted by climate change, changing weather patterns, sea level rise and flooding (Figure E3). Water

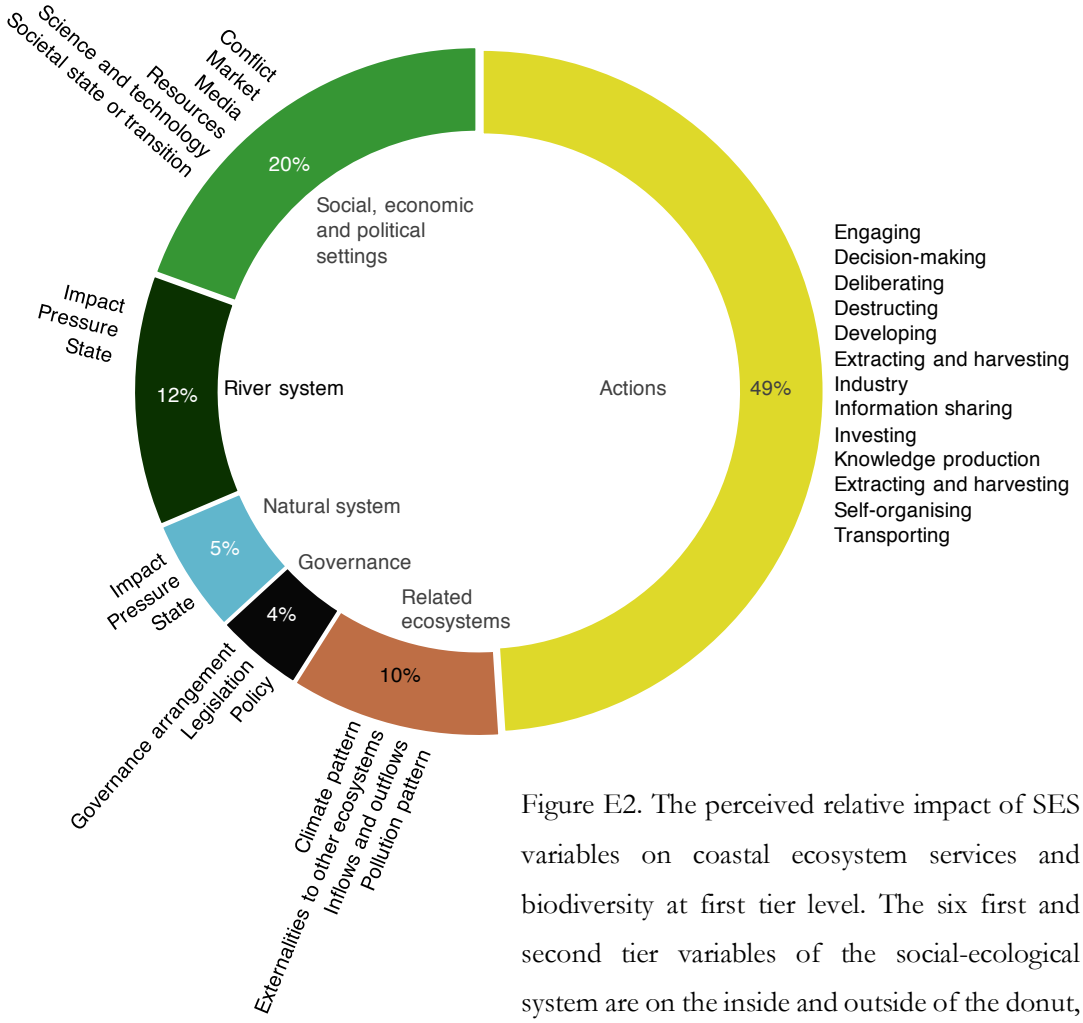


Figure E2. The perceived relative impact of SES variables on coastal ecosystem services and biodiversity at first tier level. The six first and second tier variables of the social-ecological system are on the inside and outside of the donut, respectively

filtration were seen to be most impacted by polluting, deforesting and littering (Figure E3).

E2.3 Top concerns

Fracking was the subject to most concern, being raised in all 20 groups and receiving 9.8% of total votes of concern. It was also most frequently connected to having effects on biodiversity (13/20), regulating (9/20) and cultural (10/20) ecosystem services. Participants expressed concerns over fracking leading to deforestation, toxin release, land contamination, health effects, pollution, need for more infrastructure and transport, effects on visual appearance of area, and challenges with waste disposal.

Climate change was the second most important concern, mentioned by eighteen out of twenty groups, and receiving 8.1% of total votes. Participants described how it leads to sea level rise, changing weather patterns, moods and well-being, floods, nesting area for marshland birds, coastal food chains, ice caps melting and loss of land. Pollution was third (7.1% votes, mentioned by thirteen groups), perceived to lead to ruining nature, killing animals and plants; spoiling water, ice caps melting, litter, air quality, state of the river, increase in litter, cleanliness of water. Education was the fourth important concern (5.8%, mentioned by twelve groups). Other SES variables that received more than two percent of total votes include education, government policy, housing development, population size and awareness of the environment.

The extent to which participants demonstrated local knowledge regarding different aspects of the Inner Forth are described in the following sections.

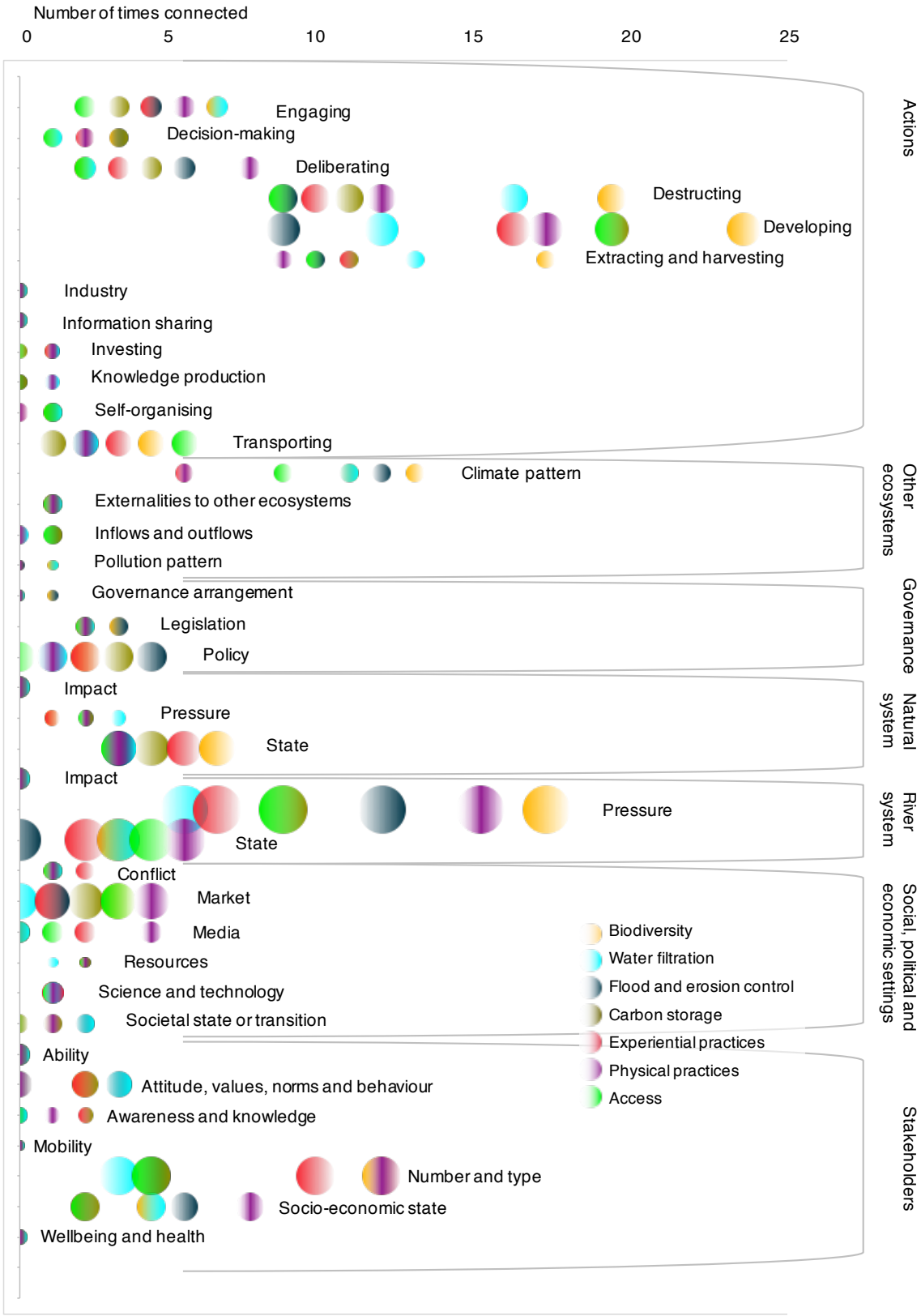


Figure E3. Overview of how workshop participants perceived the relative impact of SES variables on coastal ecosystem services and biodiversity at second tier level. The number of times each second-tier variable was connected is on the horizontal axis. The SES variables are indicated on the right. The size of the circle is relative to the number of third tier variables within each second-tier. The circles are partly transparent so that overlapping circles can be viewed.

E2.4 Direct effects between SES variables

Participants identified a multitude of ways in which social, economic and political settings directly link to the Inner Forth (Figure E4). The economic situation, mentioned by three groups, was mentioned to lead to more people spending their holidays locally. Four groups mentioned energy needs leading to fracking and mining in the area, and consideration of renewable alternatives. However, the cost-effectiveness of renewable energy production was seen to limit the uptake of renewables in the area. One group noted how social media had led to an increase in availability of information, which in turn, together with the freedom of media, was seen to shape public attitudes and perceptions and awareness of climate change. One group mentioned how internet has introduced more competition to local businesses and shops in the area.

Several types of feedbacks were identified from other ecosystems towards the Inner Forth social-ecological system. Eighteen groups mentioned climate change, which was linked to sea level rise, loss of land, moods and wellbeing, flooding, nesting area for marshland birds and ecological food chains in the tidal areas.

Participants only noted few ways in which governance directly links to stakeholders and their actions. Altogether five groups mentioned austerity measures, which were seen to lead deprivation and increased need to justify developments. Green energy policies were also seen to contribute towards public debt, and land ownership structure in Alloa was seen to enable development of Alloa Town Centre. Centralized government arrangement was seen to promote fracking in the area.

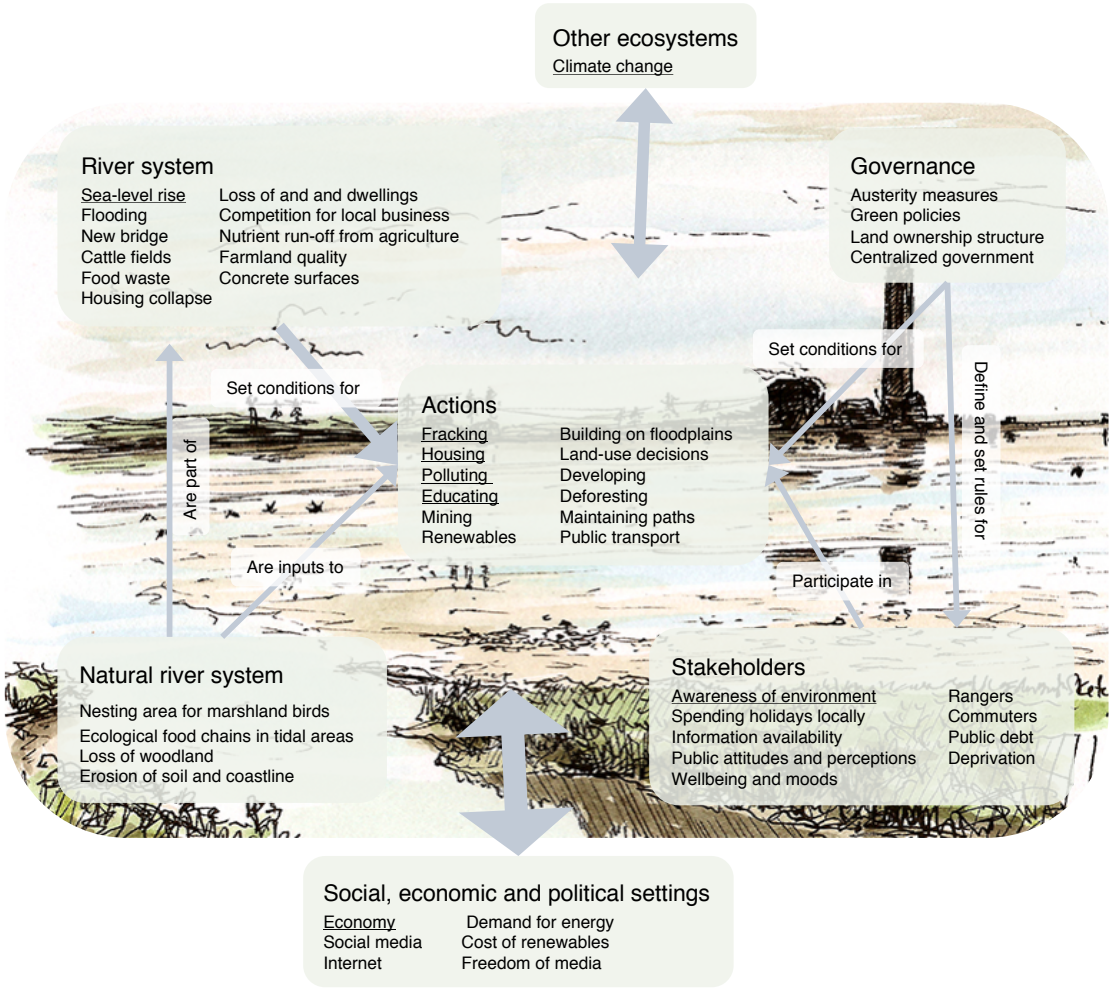


Figure E4. Direct linkages between SES components.

E2.5 Feedback loops between SES variables

The most diverse feedback that participants identified was from stakeholder actions towards the river system, many of which were related to different development actions, but also polluting, deforesting, overproducing and fracking, managing land and land-use decisions (Figure E5). Polluting, which was mentioned by thirteen groups, affects amount of litter, air quality, 'state of the river', and cleanliness of water. Deforesting was mentioned by nine groups, noted to increase flooding. Overproducing was also mentioned to lead to more food waste in the area. Fracking was mentioned to lead to

increased pressure from toxins, infrastructure, transport, and affect the landscape and views. Development activities in general, mentioned by seven groups, was mentioned to lead to river diversions and reductions in flood plain areas. Developing renewables, mentioned by eight groups, was mentioned to lead to more windfarms in the area. Housing development activities, mentioned by sixteen groups, was noted to add pressure from sewage and waste water, and reduce capacity to absorb rain water by increasing concrete coverage. Industrial development activities, mentioned by eight groups, were noted to impact visual appearance of the area. Urbanising activities, mentioned by four groups, were noted to lead to more flooding, concrete surface area, and reductions in arable land. One group noted that managing land improves drainage capacity and reduces flooding, whereas land-use decisions affect the extent of farmland area.

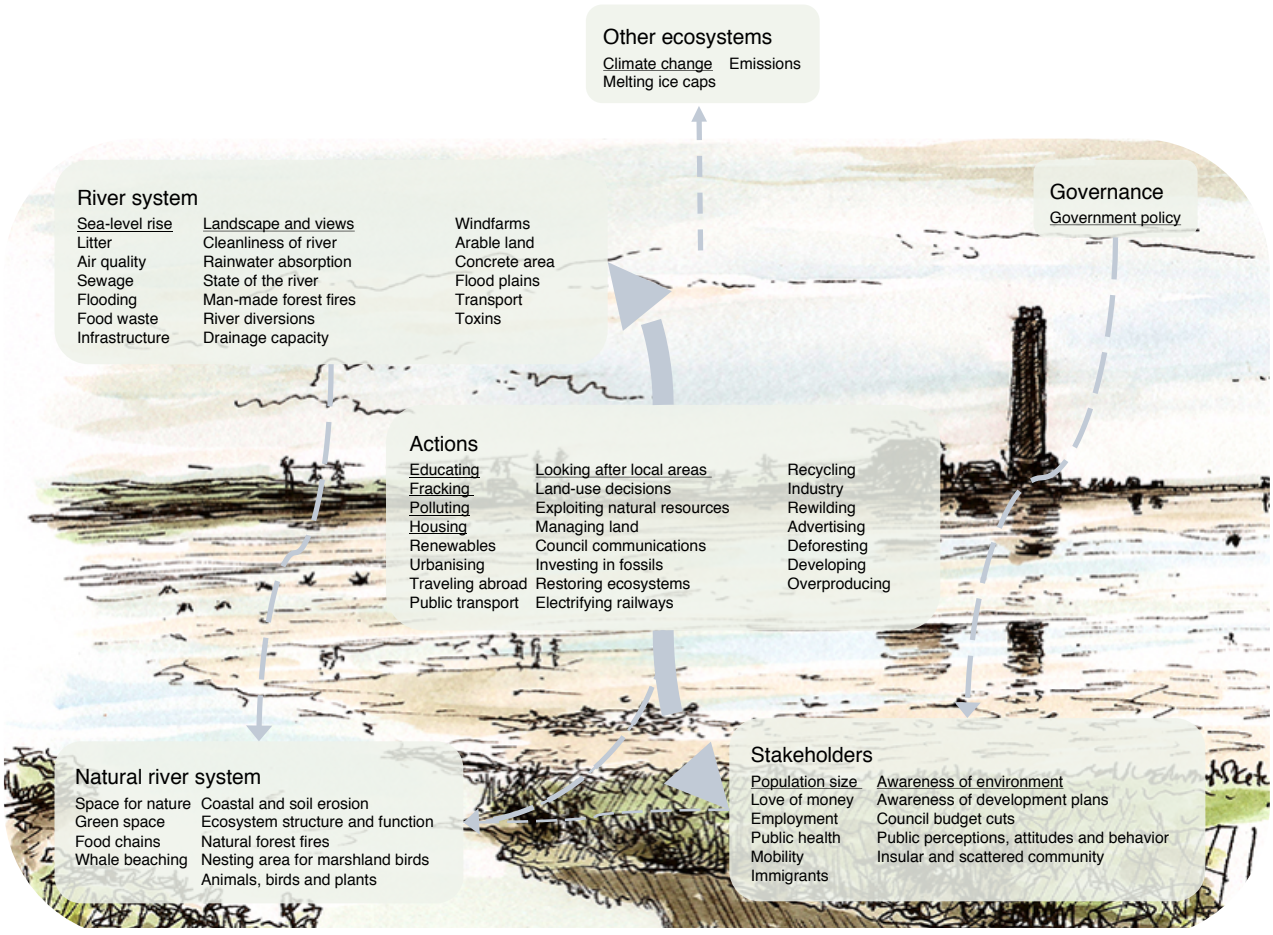


Figure E5. Feedbacks between SES components.

E2.6 Internal feedbacks between SES variables

There were many internal feedback loops mentioned for stakeholders (Figure E6). Two groups mentioned the scattered nature of the community, which made it difficult for the community to self-organise. This in turn had led to general unawareness of development plans, and lack of concern and care. One group mentioned 'love of money' leading to concerning behaviour of corporate and elite. Also, public attitudes were mentioned to affect public behaviour, and knowledge and skills to affect the number of opportunities for people. Increases in commuters and immigrants in the area was seen to contribute to the growing population size. The number of retired residents with a lot of local influence were also mentioned to contribute to a broader resistance to incomers in the area. Budget cuts in the local authority were noted to reduce the number of rangers in the area, whereas cuts in the health service were seen to affect people's health.

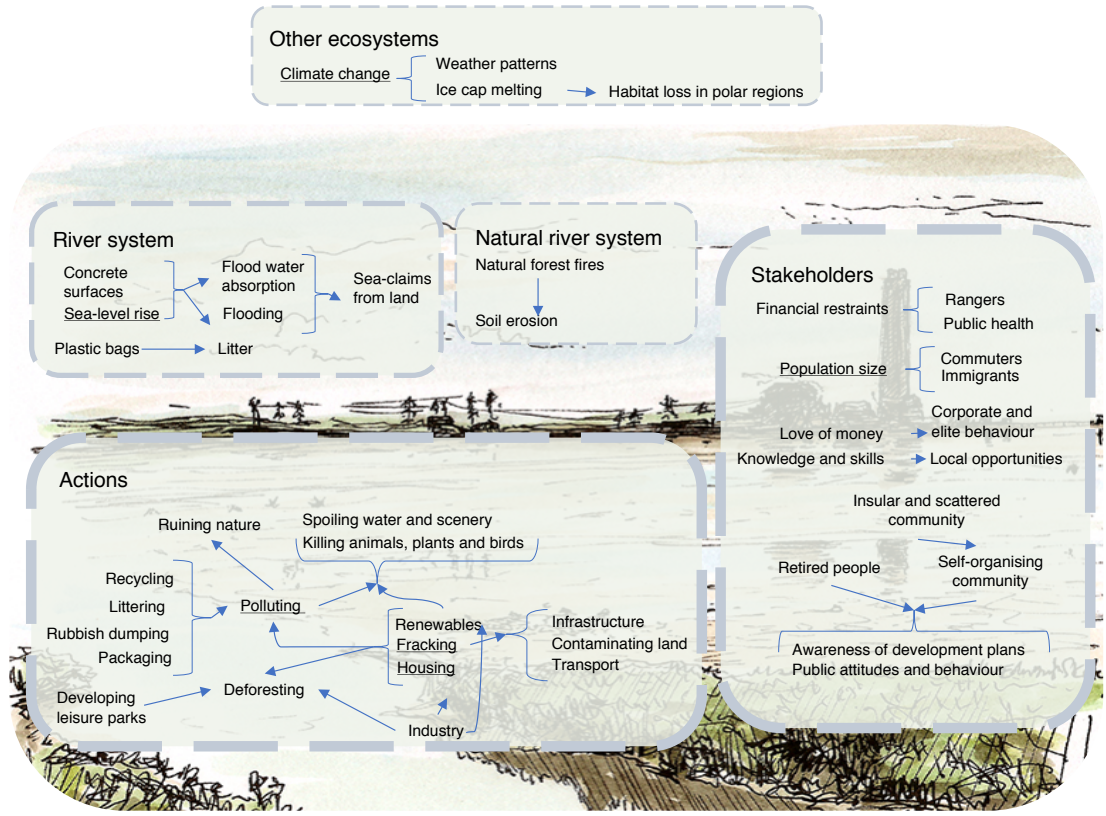


Figure E6. Internal feedbacks

APPENDIX F.

Motivations during choice tasks

'Donation' or 'money' was the most commonly mentioned determinant for participants' choices (65% of those who were asked; see Table 4). Some people also mentioned that they thought that donation in their option of choice was too high, but they chose it regardless. In such cases, the interviewer asked the participant to only choose realistic options, however, some participants did not want to choose options without any physical changes even though they expressed that the donations were not feasible for their household. Some participants also proposed to donate time instead of money.

Altogether 47% of participants expressed their motivations to arise from an overall impression of the options, e.g. 'more happening', more being done', 'more going on', 'more realistic', 'best mix', 'good balance', 'good mix of options'. Many also expressed their judgement to arise from an overall consideration of the physical changes against the donation, e.g. 'better value for money' or 'good value'.

Fifteen percent of participants expressed confusion or hesitance in making choices. These participants were either not sure, were unable to reach a conclusion, discussed issues that were not pertaining to the topic of the choice task, or did not grasp the concept of making trade-offs. Six percent demonstrated elaborate consideration of different attributes when making their choice, such that it was not possible to identify any specific attributes that motivated their choice. Five percent of participants expressed resistance and were unsatisfied with the format of the question, because they felt that none of the options

were 'good' or 'great', or they needed further information to fully consider the consequences of different options.

Groups			**Proportion**
Attributes	Donation		0.65
	Overall impression		0.47
	Access and paths	Increase	0.32
		Decrease	0.09
	Breeding birds	Increase	0.30
		Decrease	0.03
	Space for nature		0.28
	Habitat quality and conservation work		0.20
	Flooding and climate change		0.19
	Habitat restoration		0.06
	Location of sites		0.04
Not indicated	Confusion or hesitance		0.15
	Elaborate consideration		0.06
	Resistance and unsatisfaction with task		0.05
Asked	Not asked for any of the tasks		0.19
	Not asked for some of the tasks		0.55

Table F1. Motivations during choice tasks.